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Multiple Unit Plan for Compact Factory Plant

Design of New Canadian Niagara Power Project

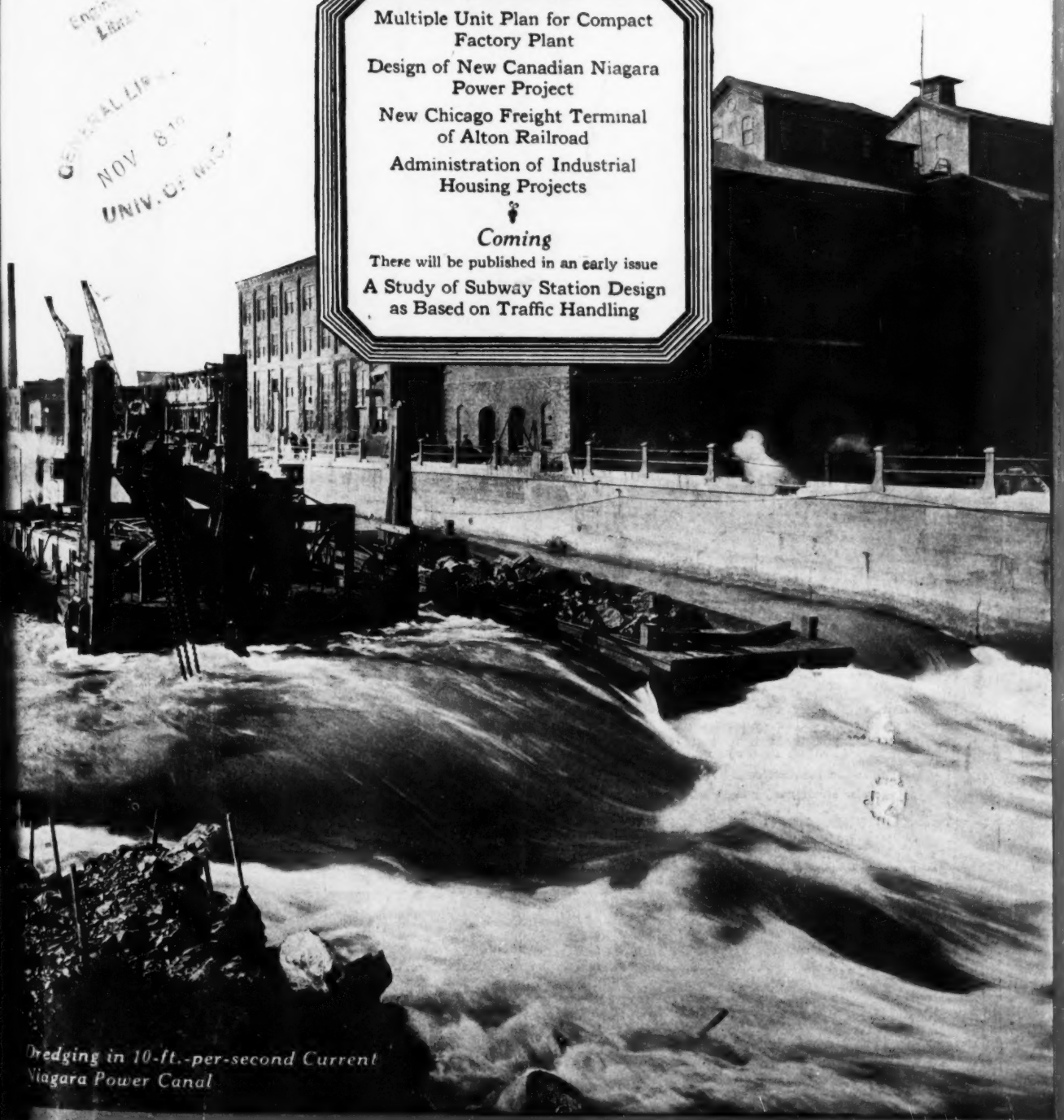
New Chicago Freight Terminal of Alton Railroad

Administration of Industrial Housing Projects

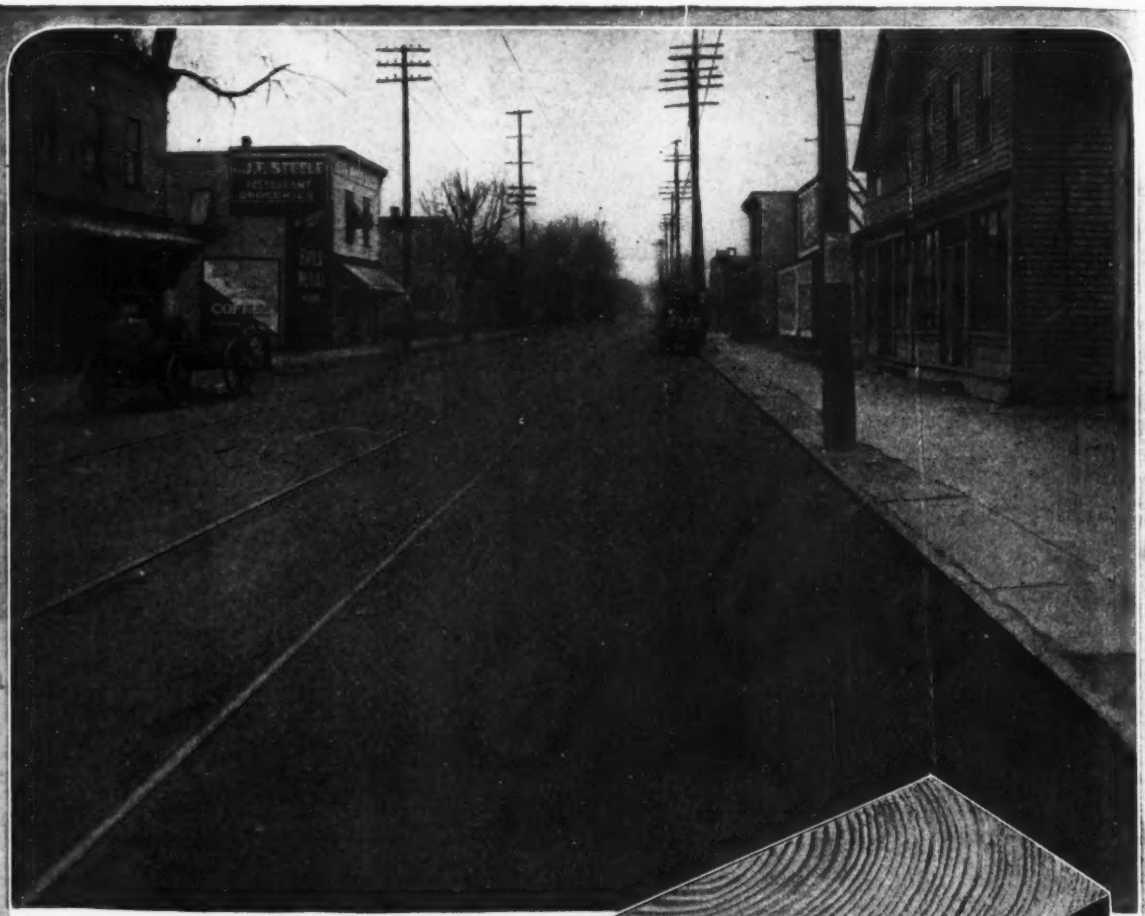
Coming

There will be published in an early issue

A Study of Subway Station Design as Based on Traffic Handling



Dredging in 10-ft.-per-second Current Niagara Power Canal



One of Toledo's Arteries

Dorr Street, Toledo, Ohio, needed repairing badly. It was almost impassable. A pavement of great endurance as well as one that was quiet and easy to truck over was necessary, as this is one of the main arteries feeding the city from the West.

Kreolite Lug Wood Blocks laid on six inches of concrete with a paint coat of Kreolite Koncrete Koating and Kreolite Wood Block Filler were finally decided upon.

This pavement was laid over two years ago and is in just as good condition as when first opened.

Write for information on this superior street paving material.

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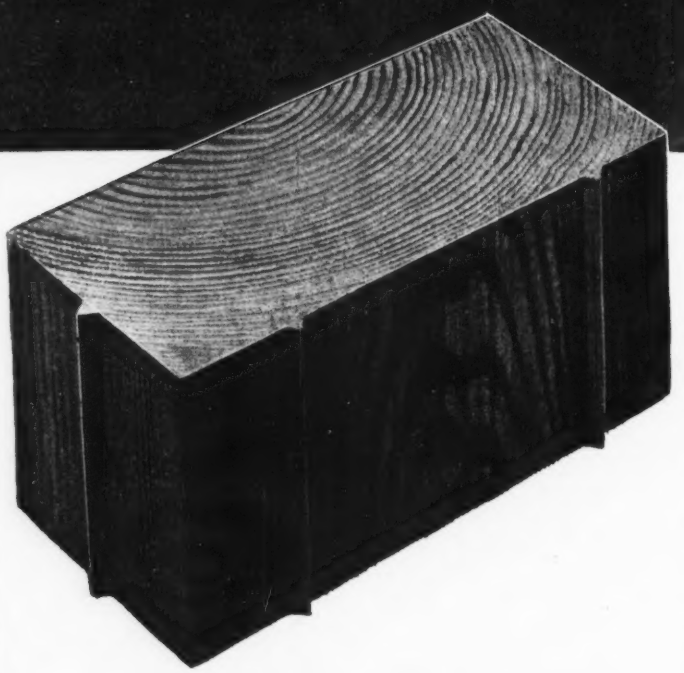

KREOLITE LUG WOOD BLOCKS

"The Paving that's Saving"

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ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING
AND CONTRACTING

E. J. MEHREN
Editor

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The Amendment Ballot

THERE is little to be said with reference to the amendment ballot of the American Society of Civil Engineers. The issues were well presented to the society, and the important ones lost by relatively small margins, ranging from 224 to 448 (see details in News Section this issue.) The defeated issues had majorities, but not the required two-thirds votes. The result accords exactly with the wishes of the 182 signers of the "Appeal." With them must rest much responsibility for initiating necessary changes. To that they have pledged themselves—a pledge all the more solemn because it has carried weight with many members of the society. The signers of the "Appeal," by proceeding with moderation, by contenting themselves with the exercise of their influence only in directions attended with little dispute, can do a great service to the society. That service is none other than the pulling of the contending factions together. In taking this position of moderation they should bear in mind that they are the representatives of the minority—a victorious minority, it is true, but a minority nevertheless.

Public Service and an Opportunity

VALUABLE public service was performed by the engineers who testified for the defense in the Boston molasses-tank trial, as reported last week, in making known the fact that tanks still in service are less safe than the ill-fated Boston tank. But it is not enough if the service is to stop there; further service is called for. Stresses well over 30,000 pounds per square inch tell a story of impending disaster that is well understood by the technical mind, yet means little to the general public. Clearly it is necessary to get these dangerous tanks out of service at once. There are ample means to accomplish this, in the law's machinery, but the machinery must be set in operation. The legal guardians of the public's safety and rights must be advised of the facts and their meaning, and this is the part of engineers. If association—or federation—for the common good has any meaning, it here finds ready to hand an opportunity and a duty.

The Philadelphia Water-Supply Report

IN ADVISING ultimate recourse to the tributaries of the Schuylkill and Delaware rivers for the water supply of Philadelphia, but with a continuance, improvement and some extension of the present supply works and rapid instead of more slow filters for additional filter units (see p. 751) the Board of Consulting Engineers has acted in accordance with the logic of events, as tempered by local conditions. Twenty-one years ago it was equally logical, considering the status of water supply engineering and of public opinion, for Messrs. Hering, Gray and Wilson to advise a continuation of the use of the Schuylkill and a large development on the Delaware, with slow sand filtration for the major part of the water from both sources. Both reports had in mind the utilization of as much as might be economically of existing plant. The present report looks forward to the time when the Schuylkill and Delaware will be polluted beyond safe use and when public sentiment will demand comparatively pure original sources of supply but will wish even those to be made safe beyond possible question by the best means known to the art of the time. As so often happens elsewhere, a change in the source of supply at Philadelphia will relieve, although in this case it will not entirely remove, the burden of pumping. Like the report of 1899 (see *Engineering News*, Oct. 5, 1899, p. 230) the present engineering board advises the adoption of a universal meter system. Had the recommendations of the earlier commission in this respect been carried out Philadelphia's high water consumption would have been reduced to reasonable figures years ago, and large expenditures for additional works now required would have been postponed.

Well Over a Hundred Million

WE ARE a nation of 106,000,000. More accurately, on Jan. 1, 1920, according to the Census Bureau's announcement, just made, the population of the United States, excluding Alaska and other Colonial possessions, was 105,683,108. Considering the effect of the war and of the influenza epidemic, it is not surprising that the numerical increase from 1910 to 1920 was less than that for the previous decade (13,710,842 against 15,977,691) and the percentage increase but 14.9 for 1910-20 compared with 21 for 1900-10. A falling percentage of population increment is to be expected as the decades go on and the population base increases, but in normal times the fall would not have been from 21 to 14.9 per cent. To engineers particular interest lies in the growth of our urban population, which has now passed the rural. Specifically, the population in incorporated places of 2,500 or more is now 54,816,209 or 51.9 per cent of the total. The corresponding percentage in 1910 was 46.3. If all incorporated places are taken into account then 9,864,196 people are added to the urban population, making a total of about 65,000,000 urban and only 41,000,000 rural, or percentages of some 61 and 39, using round numbers. What this means in terms of municipal utilities, which it is the function of the engineer to design, build and, to a large but not yet sufficient degree, to operate, is a subject for reflection. But the engineer is called upon to help supply various needs of the rural as well as urban populations, as witness particularly the railways, the highways, besides irrigation and drainage works. Highway engineering, in the past decade, has increased out of all proportion to the increase in population. Doubtless this disproportionate growth will increase. In other fields, too, the demands for engineering service, between

now and the next census, will grow faster than the population. All this the engineer and his profession should prepare for—not forgetting a bounden duty to raise the quality as well as to meet the increasing quantity of engineering work.

New York's Transit Plans

ONE of the most significant statements made by Mr. Turner in his report on the comprehensive transit plan for New York City, discussed in greater detail on page 754, is that "it has averaged about ten years from the inception of previous general transit projects to the date of operation of the lines." To the resident of New York familiar with the enormous congestion on existing trunk line subway routes during rush hours, the timeliness of this warning should be apparent. The need for additional transit facilities is here now, and the important thing to remember is that, due to the length of time required for the preparation of detailed designs and for the building of the subway structures themselves, relief cannot possibly be provided quickly. The same line of reasoning applies to other public utilities, such as water supplies. Here, also, it is necessary to look well into the future and to foresee the needs of a growing population before those needs are actually existent. In the case of its additional supply of water from the Catskills, New York City, by beginning work more than a decade ago, acted wisely, with the result that today the supply of water is ample. The city has to thank its engineers that this condition exists. Especially in New York, where the population has reached its present great numbers, the provision of adequate rapid transit facilities is second only to furnishing a sufficient supply of water for drinking and industrial purposes. Those officials responsible for public works policies must realize the supreme importance of advance planning for such time-consuming projects as the construction of subways under city streets. Mr. Turner has looked ahead and has presented recommendations for extensions to existing routes and for new trunk lines and feeders which, as far as conditions now can be foreseen, will serve New York's increasing population until the year 1945. The report should be considered not as a document containing merely interesting technical detail, but as a clear warning to begin work now on carrying out the comprehensive rapid transit plan for which, unless all past signs are wrong, there will soon be a critical need.

A Neglected Transit Problem

NEW YORK CITY is just now completing its mammoth system of rapid transit begun seven years ago after many more years of planning, but already the duly appointed body has announced the fundamentals of the next new network of lines which may not be begun for some years, but which proper judgment already foresees. Such planning ahead is necessary in municipal matters as in private business. But New York's transit needs are by no means completely cared for by the machinery now provided. To the west of Manhattan Island, and separated from it by a wide river, lies a large proportion of the so-called metropolitan district. From and to that area come and go daily tens of thousands of people who help to make New York what it is and who now, by virtue of the New York income tax, contribute directly no little to the income of the State. For their ready crossing of the Hudson there has been no new means provided since the completion of the tortuous Hudson & Manhattan Ry., nearly fifteen years ago, though travel has been increasing at a rate corresponding to the growth of rapid transit traffic throughout the city. Worse still, the ferry service, on which most of the travelers depend, has, if anything, grown less. Rush-hour congestion in the Hudson River crossing, particularly in the tubes, has already reached the limit of endurance, but except for the new highway tunnels, which can hardly do much to relieve commuting congestion, no planning whatever is being done for the future. The metropolitan district has no political entity and has therefore no one to do its planning or thinking. For some years an effort has been made to provide an interstate body to consider the port of New York, but so far local selfishness has prevented its formation. Possibly such a body, if or when formed, may be able to undertake passenger as well as freight transportation. But if it cannot, it is high time that some steps be taken toward the formation of an interstate transit planning body. New York needs its Jersey suburbs, and the suburbanites need New York, but the time is not so far distant when both will suffer unless better transportation is provided.

Railway Labor and the Camp Train

TO WHAT extent are the railways improving the housing accommodation for construction and maintenance gangs, or profiting by the numerous indications of the growing necessity of such improvement in order to meet labor conditions of the near future? Undoubtedly, some railways are taking action, but is the movement as general as it should be? These questions are suggested by the continued apppearance of the typical pre-war boarding train or camp train, even on important railways. Such a train is composed of dirty and more or less dilapidated box cars, with a few small windows knocked in the sides and a minimum of equipment, and while serving as a camp the surroundings are littered with paper and refuse.

An excuse given sometimes is that the men are foreigners and prefer to live in their own way. As to methods of living and cooking that may be correct. But it is doubtful if any laborers prefer to live in dirty and ill-kept quarters or would object to simple matters of cleanliness and tidiness if anyone took the trouble to instruct them. They may have been used to bad conditions abroad and therefore find no great fault with them in the new country. In order to make good Americans of these men, however, they should be shown the advantages which they may enjoy here. This is not simply a patriotic or uplift idea; it is distinctly practical and economical. If a railway organization will not see the signs of the times and is content to follow old and slipshod methods when better methods mean better work and better men, then it will have no ground for complaint if it finds its forces are of low caliber and poor discipline, its labor turnover is excessive and its work is poorly done.

Many contractors have recognized the signs and now provide camp accommodations far superior to what was considered adequate five or six years ago. They do this because it pays and is in fact necessary in order to maintain a force of satisfied and competent men. Perhaps some have a higher motive also.

Livening Society Meetings

EVERY ENGINEER who has attended engineering-society conventions knows how tiresome they are apt to be. Every society officer who has made up the program of such a meeting knows the difficulty of the job. The former remembers how often the program is a long list of a dreary papers presented in an uneasy manner by men unaccustomed to public speaking; the latter is usually bound by the tradition that such a program is a necessity which he cannot avoid. In the specialist societies, such as those devoted to water-works, testing materials and concrete, long lists of papers are to be expected. They need not be dreary, in fact they rarely are, and the men who deliver them and those who listen are equally expert and equally interested. But in the general societies, particularly the local ones whose members are of all branches of engineering and whose bond of sympathy is the fact that they are all members of the same profession, the problem is different, albeit the solution is generally the same. The consequences are that only a minority of those present are interested in any one paper and that the papers have to be multiplied interminably to offer something to everybody.

The Engineering Institute of Canada seems to have taken a step forward in its so-called "professional meetings" which well may be looked into by other societies. These are held in various parts of the Dominion and are under the direction of the local branch. They attract engineers of every specialty. Instead of trying to present a rounded survey of the state of the art and science of engineering, the program is centered on one or two of the outstanding engineering works of the district, which are made the subject of complete explanatory papers and the scene of actual inspection. At Niagara, for instance, two weeks ago, the Welland canal and the Queenston-Chippawa power project, both of such importance that no engineer worthy of the name can afford to be ignorant of their details, were the only subjects discussed outside of a short session devoted to purely professional matters which also had universal appeal. The consequence is that those who attended the meeting learned something about these two great works and at the same time were not bored at any of the sessions. Better everything about something than something about everything.

In addition, the Canadian engineers emphasize the social side of their meetings. To be sure, in the past there have been criticisms that certain of our technical-society meetings are nothing but junkets, which only those with abundant leisure can enjoy. But there is a happy medium which permits the fullest of social intercourse, the necessary mingling of men of a common interest, and at the same time provides enough solid technical matter to justify a busy man spending his time and money. So at Niagara there were luncheons and dinners and smokers—in fact, only at breakfast was the visitor required to seek out food on his own resources. At the end of the three days these engineers knew each other better, which is a requisite of professional integration, and they had learned besides some things which were useful in their work.

There is no intention of claiming that only in Canada are these things done, or that there they are always done. But this is a recent instance of a pleasant and profitable society meeting which stands out among the many that it is the duty of a technical editor to attend. Now that the winter season is coming on, with its sectional and state society meetings all over the country, it seems a good time to call the attention of program makers to the possibilities before them. Let them not be bound down to the tradition of having only dry descriptive papers, but seek out some subjects which will interest everyone and emphasize them. Then if they provide opportunities for the men to get together between sessions, they will find that their members will go home better pleased and more inclined to come again.

Consider the Annual Snow Problem

THE snow-handling problem is too frequently an emergency that finds cities, railways and other utilities unprepared. With winter approaching, therefore, it is pertinent to call the attention of engineers and municipal officers to the great desirability of giving early and earnest attention to the subject. Here is a field in which the engineer may take the initiative.

In a majority of cases this preparation is a matter of getting out the old equipment and applying old methods. But this is no reason why the engineer should not try to look at the matter in some new light, to recall his experiences, to introduce new ideas, or to promise himself that he will tackle the problem more seriously or more successfully than ever before. It is a poor policy to wait for trouble to come before considering it. A few snow-removing machines are on the market. Experimental machines reposing in sheds should be put in working order with a view to getting actual service out of them. Old equipment should be overhauled and made ready long before snow falls.

Of great importance is the preparation of a plan of action. What additional equipment is needed? Can it be obtained? Where shall snow be deposited? How can rules for sidewalk clearing be enforced? How about clearing gutters and around hydrants? What are the special points of difficulty, such as steep grades or congested streets? What is to be the system of organization? Who is to have responsible charge? How are regular and emergency forces to be recruited? What co-operation can be effected with street railways or with trucking contractors? The engineer may well draft his own questionnaire and proceed to answer it.

It will be a wise move also to discuss the matter with the higher officials, the mayor and aldermen, explaining diplomatically the needs and conditions, pointing out former unpleasant experiences and showing that efficient handling of the difficulties will be duly appreciated by the people.

For the railway superintendent and maintenance engineer having charge of city terminals there are difficult problems and hard experiences in clearing passenger tracks and freight yards and keeping driveways open in order that freight may be brought to and from the freight houses. Is there nothing to be done but to wait until the snow comes and then try to hire gangs of hand shovelers for slow and tedious and more or less ineffective work? In both municipal and railway experience the best laid plans may go astray, or perhaps the snow problem may not prove serious next winter. But in either case something will be gained and nothing lost by the mere mental and physical activity of preparation. Much has been heard about the advantages of preparedness. Why not prepare, now, for next winter's snow fighting?

New Chicago Freight Terminal of Alton Railroad

Track Layout on Restricted Area—Double Deck Freight House—Team Yard Approached By Inclines—Warehouse and General Offices in Main Building—Elevator Connections with Freight Tunnels

IN UTILIZING to the best advantage a site of limited area and irregular shape for a new city freight terminal at Chicago, the Chicago & Alton R.R. has adapted the track arrangement to the peculiar restrictions of shape and size of the site and has designed buildings which form an unusual combination of double-deck freight house, warehouse and office building. This freight terminal the general layout of which is shown in Fig. 1, is on the west side of the river, between Polk and Van Buren Sts. It will take the place of old local freight houses and team yards that have to be removed to make way for improvements in connection with the reconstruction of the union passenger station.

Two buildings are provided, arranged in tandem but separated by Harrison St., and having their principal entrances on that street. On the north side will be the steel framed main building with six stories in the office section fronting on Harrison St. and three stories in the freight house section at the rear. The other building will be a two-story freight house, having the lower part of steel and the upper part of reinforced concrete. Prominent features in the steel structural design of the larger building are unsymmetrical arrangement of columns and the introduction of trusses, girders and cantilevers as supports for upper story columns. In both buildings there is an extensive use of plate girders in the floor framing for the purpose of getting large panels and reducing the number of interior columns. Upper floors to accommodate the general offices of the railway company have been provided in order to eliminate the present expense for rented quarters in an office building. A description of the main building appears in the article which follows.

Double-Deck Terminal

Since the streets in the vicinity are elevated to approximately the level of the bridges across the river and all tracks are on the original ground surface, which is practically the basement level of the buildings, the freight terminal itself will be a double-deck station, as shown in Fig. 2. Thus the tracks and car platforms of the station will be in the basement, with the rails about 3½ ft. above the normal water level of the river. The team driveways and platforms will be on the upper or first floor, at the street level and about 25 ft. above the water. Large automatic electric elevators will connect the upper and lower platforms and will extend to the second or warehouse floor in the main building.

Both through and stub tracks are included in the layout of the track floor of the buildings, as the yard arrangement makes it impracticable to have all tracks continuous. For inbound freight there will be four tracks of varying lengths, served by a 27½-ft. platform. Two of these will be stub tracks and one will have both a stub end and a ladder connection. For outbound business, seven tracks will be arranged in two groups, separated by a 31½-ft. platform, the inner group being served also by a 10-ft. trucking platform between the inbound and outbound tracks.

Each building will have a double driveway on the first floor, opening from Harrison St. and extending between the inbound and outbound platforms, which are parallel with the train platforms below. In the larger building the driveway will be divided by a row of columns and will be continued beyond the building on a viaduct extending to Van Buren St., thus giving a through connection between the two streets which cross the terminal. A separate short driveway on the west side will serve the office section of this building. At the smaller building, the driveway will extend about 40 ft. beyond the platforms, to form a turning place for teams and trucks.

Of particular interest is the provision for a future driveway viaduct along the west side of each building and above the tracks which run parallel with it. The wall columns and wall girders of the buildings are designed with attachments for girders or floor beams to carry this driveway, the outer ends of the girders being attached to columns on the joint right-of-way line. The latter will support a parallel but independent viaduct extending over the main tracks running alongside the freight terminal.

Track Layout of Terminal

Fig. 1 shows how the entire track layout has been governed and restricted by the shape of the terminal site. The site is approximately a right-angled triangle, the side on the west being formed by the main line approach to the Chicago Union Station, the diagonal side being the river and the base being formed by the great freight station of the Pennsylvania System, which fronts north on Polk St. In the acute angle of the base are two private warehouses which are served by yard tracks. The entrances to the site are limited to very narrow spaces at the right angle and at the apex, giving two main track connections at the former and only one at the latter. There are 32 body tracks, with a capacity for from 2 to 34 cars each, and a total capacity of about 460 cars. In maximum dimensions the triangular site is about 1,750 ft. long and 475 ft. wide.

The major portion of the space is occupied by the freight station, with the team yard between the building and the river. This team yard will have five driveways and eleven tracks, two of which will be connected at both ends, the others being stub tracks. One driveway will be extended to serve a group of three tracks at the south end. An inclined driveway of 3 per cent grade will lead down from Van Buren St. to the team yard, alongside the driveway viaduct approach to the first floor. At the south there will be access from this yard to Polk St. by a driveway extending between the warehouses and then turning into an incline on a viaduct parallel with the street, which it will reach by a grade of 4.17 per cent. This incline will pass through the warehouse, as shown in Fig. 1. Both warehouses are to be entered by tracks and the dock on the river front will have a short track to serve barge and steamship business. A dock shed will be built under the driveway incline. The driveways will be paved with concrete and the inclines with granite block.

Most of the house tracks are connected with the track system at both ends, but two of them are stubs

owing to the necessity of carrying two entrance tracks and a driveway from the north end diagonally along the narrow space between the building and the river. Parallel tracks are spaced usually 13 ft. c. to c. except at platforms and driveways, the spacing in the latter case being generally 40 ft., but 23 ft. in one restricted location. Ordinarily cars are not weighed here, but one of the through tracks in the team yard is fitted with a 100-ton scale having a 40-ft. table to provide for weighing freight in carload lots when necessary.

Yard and house tracks will be laid with 80-lb. rails and owing to the restricted end connections the frogs will be mainly No. 7 and No. 6, with No. 5 at a few points. In general the sharpest curves will be of 14 deg., although one of 18 deg. is required. As the subgrade is little more than 3 ft. above water level the tracks will be ballasted with broken stone 12 in. deep under the ties and drainage of surface water will be provided for by a system of transverse drains.

Steel and Concrete Freight House

The two-story structure south of Harrison St. is for freight purposes only, with no upper floor for storage. On the lower floor are seven tracks for outbound and four for inbound service, the tracks and platforms being continuous with those in the main building. On the upper floor, level with the street, are two parallel buildings, 460 ft. long, the outbound house being 38 ft. wide and the inbound house 46 ft. wide. Between them is a 64-ft. driveway. Longitudinally, these buildings have 20 ft. bays, with steel rolling doors in each bay on the driveway side. A sectional elevation and framing plan are shown in Fig. 2.

Steel construction is used for the lower or track story, the framing of each building consisting of two rows of wall columns supporting transverse plate girders, so that the freight house space is unobstructed by intermediate columns. A fifth or central row of columns under the middle of the driveway carries the driveway floor beams, whose outer ends are framed against the wall columns of the buildings. Longitudinal I-beams extend as stringers between the girders and also as struts between the columns. In the south end bay of the outbound house the interior line of single 10-in. I-beams is replaced by a pair of 15-in. channels which extend outside the wall to form the support for a freight-handling derrick. Some of the girders and other steel parts are shown in Fig. 3.

Concrete pedestals for single columns and footings for pairs of columns are supported on 35-ft. timber piles. All columns are of H-section, built up of a 12-in. web plate and four angles 6 x 4-in. but the outer wall columns of the outbound house are reinforced by 13-in. cover plates on the outside face as they have connections for future 60-ft. box girders which will allow of carrying an additional driveway along the west side of the building by supporting it over the tracks. The farther ends of these long girders will be carried by columns erected on the joint right-of-way line and supporting a similar and parallel driveway or viaduct (not for the Chicago & Alton R.R.) over tracks parallel with the viaduct.

A light reinforced-concrete construction was adopted for the upper story, as being more economical, especially as no provision is made for additional stories in the future. Concrete casing is applied to all steel work, the 4-in. casing of the columns being extended as part

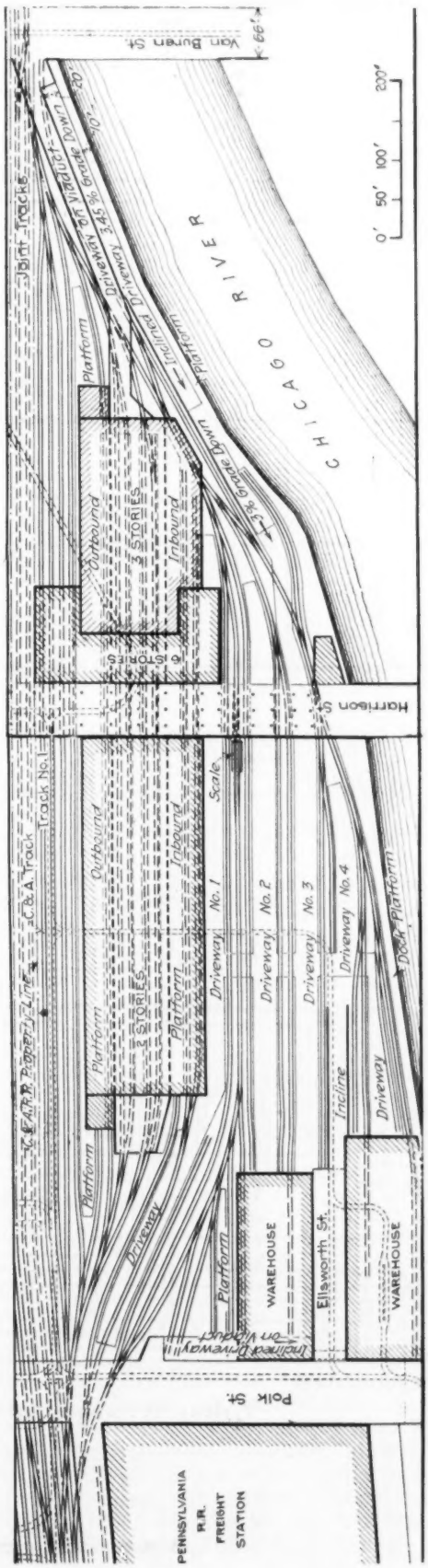


FIG. 1. LAYOUT OF CHICAGO FREIGHT TERMINAL, CHICAGO & ALTON R.R.

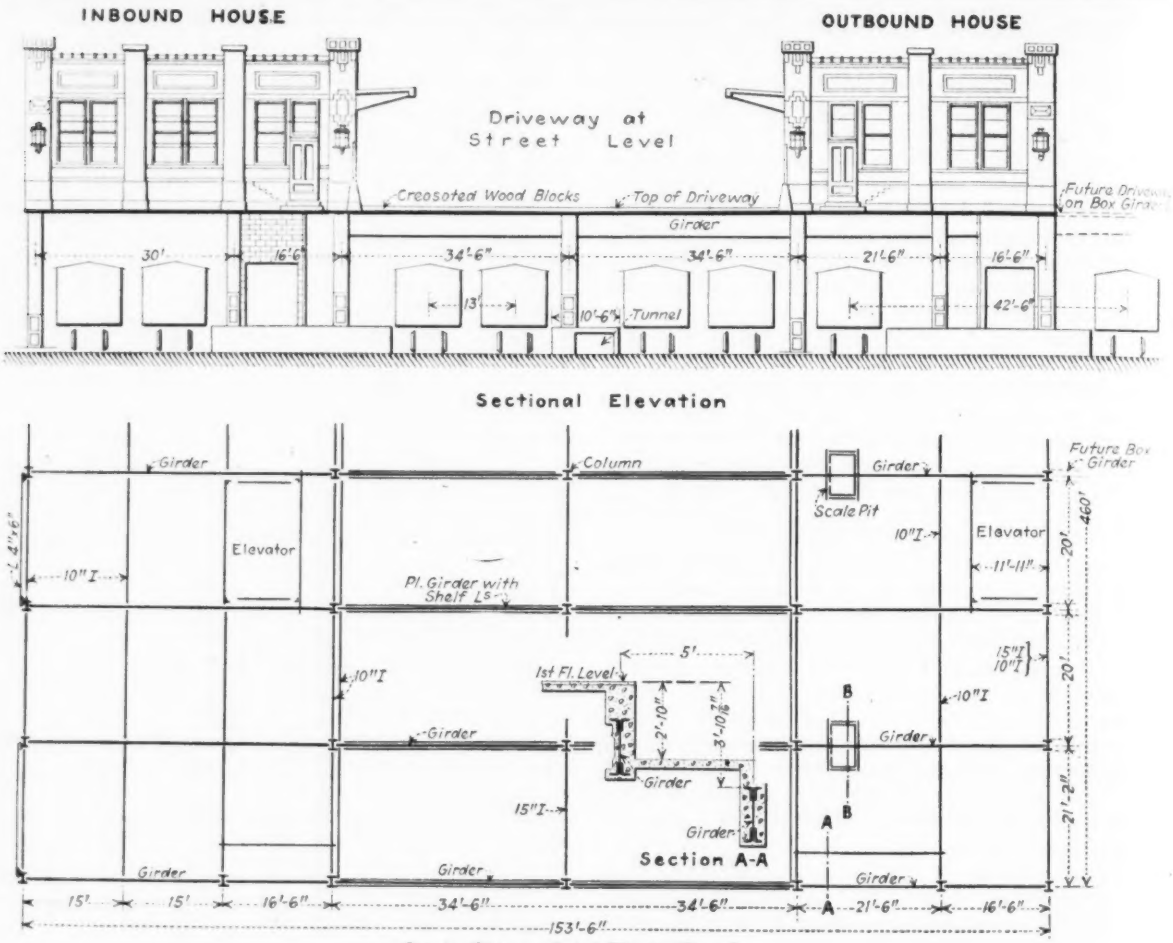


FIG. 2. DOUBLE DECK FREIGHT HOUSE WITHOUT INTERIOR COLUMNS

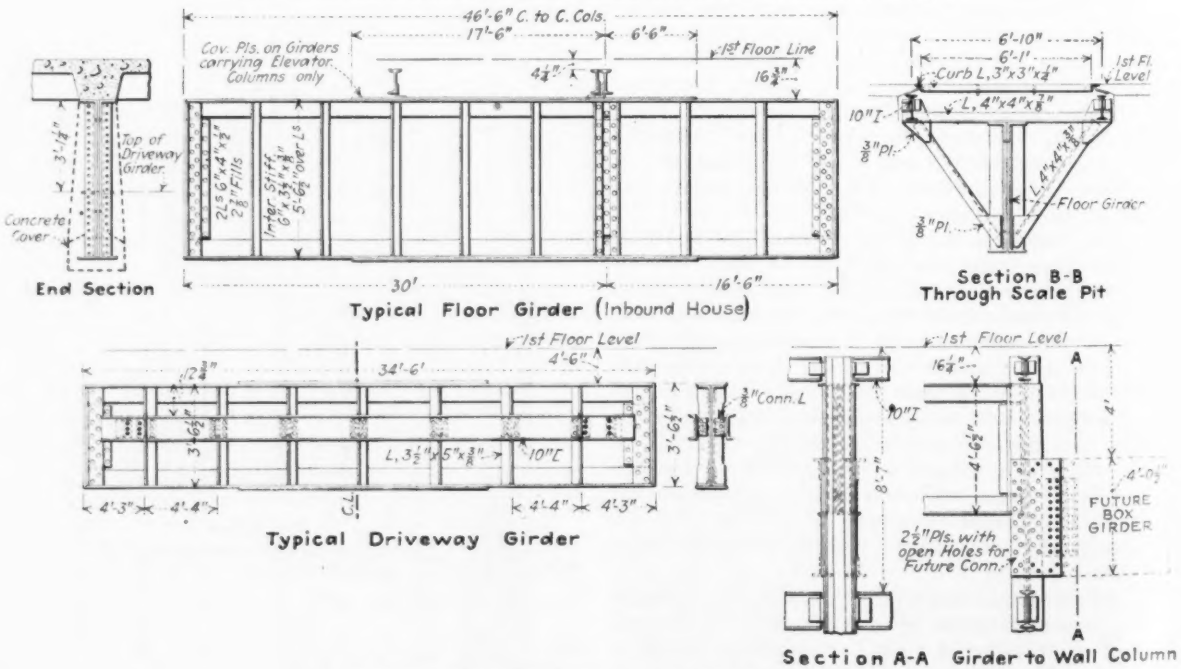


FIG. 3. STEEL GIRDERS FOR FLOOR FRAMING

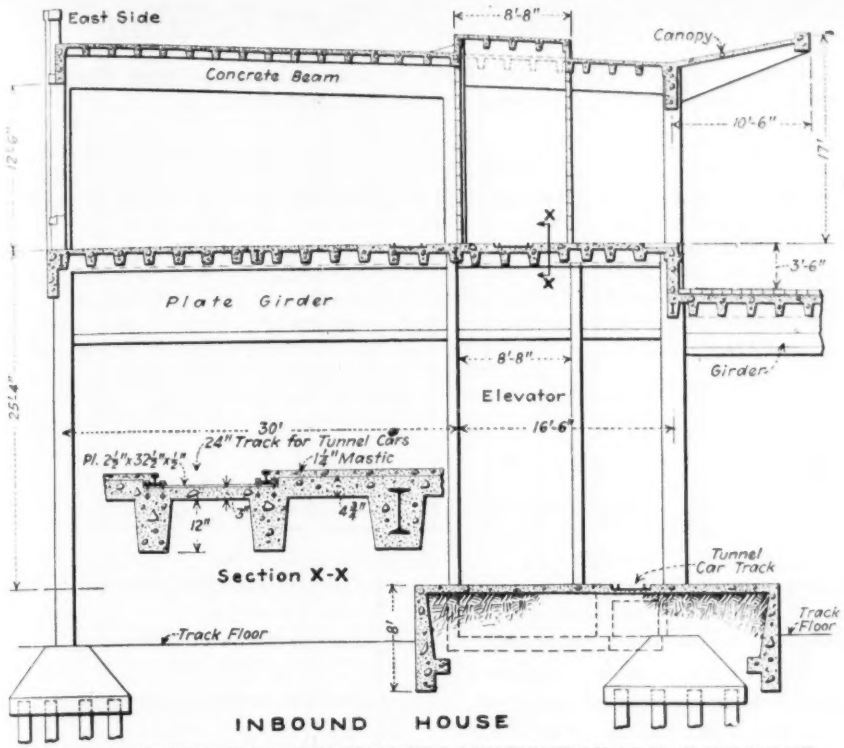


FIG. 4. COMBINED STEEL AND CONCRETE CONSTRUCTION OF FREIGHT HOUSE

of the concrete columns of the upper floor, at the street level.

Ribbed concrete slabs are used for the floor or platform and for the roof, the former resting on the plate girders and the latter being supported on concrete cross girders, as shown by the section, Fig. 4. These concrete girders extend as cantilevers 10½ ft. long to carry a flat slab canopy over the driveway to protect goods while being loaded and unloaded. A longitudinal beam or strut connects the ends of the cantilevers. The edge of each platform is protected by a 10-in. I-beam attached to brackets on the tops of the steel columns and faced with a continuous bumping timber. A similar ribbed concrete deck construction is used for the driveway, but here the end beams of the concrete panels rest on shelf channels on the webs of the girders, instead of upon the top flanges. The driveway has a 6-in. slab and is paved with creosoted wood blocks. The floor and driveway slabs are designed for a live load of 300 lb. per sq.ft.

Narrow-Gage Freight Tracks

On the platforms at each floor will be tracks of 2-ft. gage for the cars of the underground freight-handling system of the Illinois Tunnel Co., these cars being handled by elevators in deep shafts. For the inbound house there is a single oval shaft 14½ x 8½ ft., but the outbound house has a double shaft of the same shape, 28 x 8½ ft. The tracks on the platforms are of 20-lb. rails bolted to flat transverse plates which are spaced 36 in. c. to c. and are laid upon the concrete. There is no concrete filling between the rails, but on the outside the mastic floor is level with the rail heads. Freight elevators between the two floors are provided at every third bay in the outbound house and every fourth bay in the inbound house, these elevators having cars 10 ft. 6 in. x 17 ft. 9 in. Platform scales are provided in every second and fourth bay of the outbound and inbound houses respectively. A description of the larger warehouse and office building is embodied in the article which follows.

The building is unusual in combining a freight house, a warehouse and an office building, embodying special structural features. Heavy trusses are used to support the floors over the freight platform and driveway. Special girders, carried on columns so spaced as to clear the tracks, support columns of different spacing for the upper floors, details of which are shown.

This terminal was designed under the direction of H. T. Douglas, Jr., chief engineer of the Chicago & Alton R.R., the structural details being worked out by W. F. Rech, bridge engineer. The steel work was fabricated by the American Bridge Co. The contractors are W. J. Newman Co., Chicago, for the foundation piers; the Mellon-Stuart-Nelson Co., Chicago, for the smaller buildings, and the Dwight P. Robinson Co., New York, for the superstructure of the main building.

$139,000,000 Cost of Catskill Development

The first stage of the Catskill water supply development for New York City having been essentially completed, J. Waldo Smith, chief engineer, in his annual report for 1919, summarizes the extent of the operations of this project from the beginning of the preliminary investigations in August, 1905, down to the present time:

On Oct. 9, 1905, a complete plan for the development of the Catskill watersheds was submitted to the Board of Estimate and Apportionment. This plan was approved by that board on Oct. 27, 1905, and by the State Water Supply Commission on May 14, 1906. The first contract for aqueduct construction was awarded on March 27, 1907, and the first sod was turned by Mayor George B. McClellan on June 20, 1907. Thereafter contract followed contract and the work was advanced so that storage of water in the Ashokan reservoir was begun on Sept. 9, 1913, and Catskill water was first delivered into the distribution systems of the city on Dec. 27, 1915.

The work of exploration and construction was done under 69 agreements and 140 contracts aggregating, together with the work done by force account, a total of $103,013,905.64. Other expenses, including administration, engineering and police, equipment, supplies, acquisition of land, damages and taxes to the end of 1919, bring the total cost for the first part of the Esopus development to $139,050,889.55.

Double-Deck Freight Station in Six-Story Building

Steel and Concrete Structure—Trusses and Girders Eliminate Interior Columns—Upper Floors for Company Offices—Structural Provision for Future Driveways

AN UNUSUAL combination of freight house, warehouse and office building, involving special structural features in the way of trusses and girders, is provided in the main structure of the city freight terminal now being built at Chicago for the Chicago & Alton R.R. This terminal is described on p. 728 of this issue. The novel but logical purpose of the office section is to provide the railway company with general headquarters on its own property and thus eliminate the expense of rented offices.

This building will be 340 ft. long, with a six-story section having a frontage of 236 ft. on Harrison St., behind which will be a three-story section 153 ft. wide. The basement and first floor will form a double-deck freight house, with tracks at the lower level and with the entire first floor (at the street level) for team driveways and freight platforms. The greater part of the second floor will be for warehouse purposes. In the office portion of the building, the third floor will have the freight department, filing and storage rooms for freight records and also a lunch room. On the fourth floor will be the financial departments. On the fifth floor will be the offices for the president, general manager and chief engineer, with drafting room and other accommodation. A sectional elevation of the six-story office portion of the building is shown in Fig. 1, together with a typical portion of the first-floor framing plan.

Steel frame construction is used throughout, and in the lower floors it consists largely of plate girders, with girder and cantilever supports for upper columns over tracks and open floor spaces. Trusses and longwall girders carry one part of the building over a group of tracks. The structural scheme will be understood from Fig. 1 and the general first-floor framing plan, Fig. 2. Ribbed concrete floors, ribbed and flat slab roof, concrete and tile casing for all steel work, and brick with terra cotta trimmings for the outer walls, constitute the other structural features of the building.

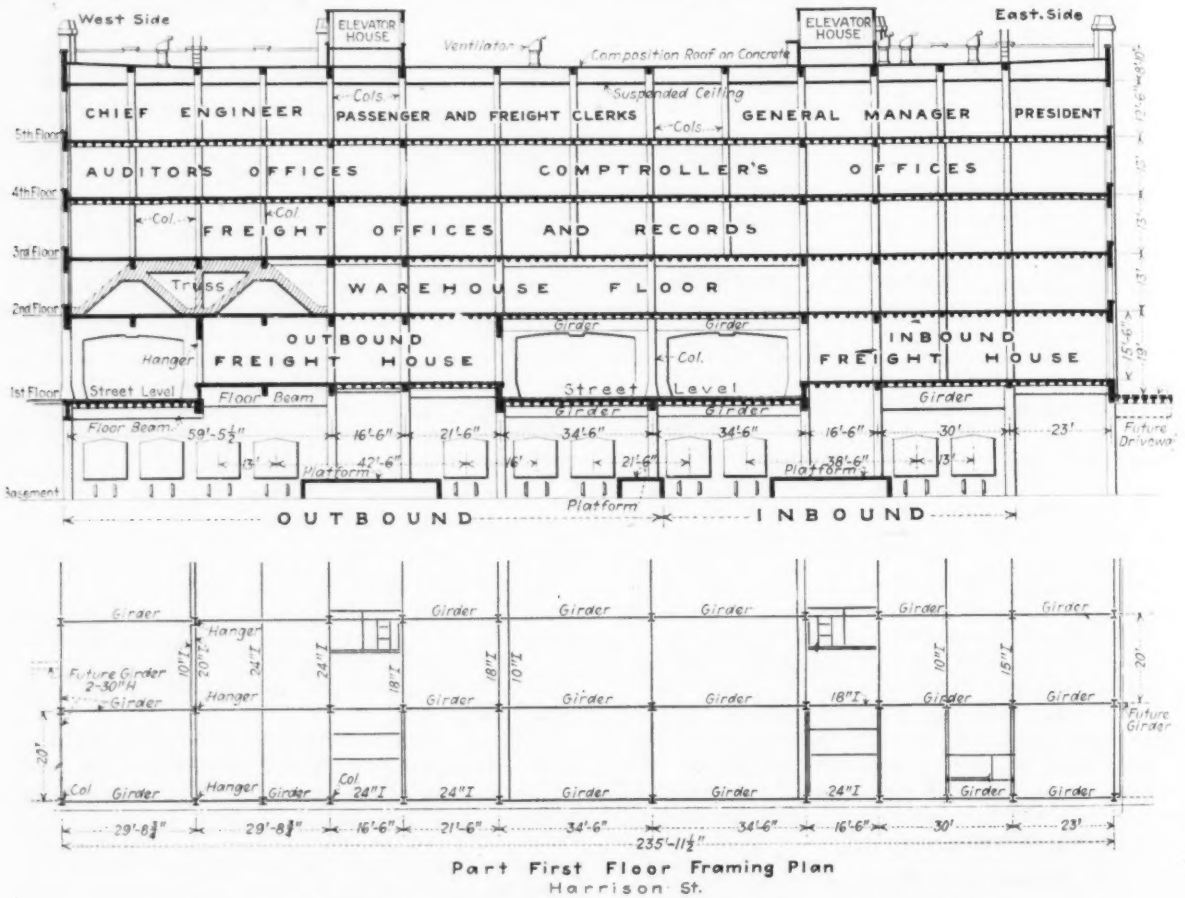


FIG. 1. SIX-STORY FREIGHT AND OFFICE BUILDING, CHICAGO & ALTON R.R.

In addition to the broad interior driveways, attention may be called to the provision for future outside driveways on both sides of the building, these to be carried by girders attached to the structural framing, as indicated by the plan in Fig. 1. For the driveway on the west side, which will be over tracks running longitudinally under it, there will be pairs of 30-in. H-beams framed against wall girders in the building and against an outer line of girders carried by columns on the

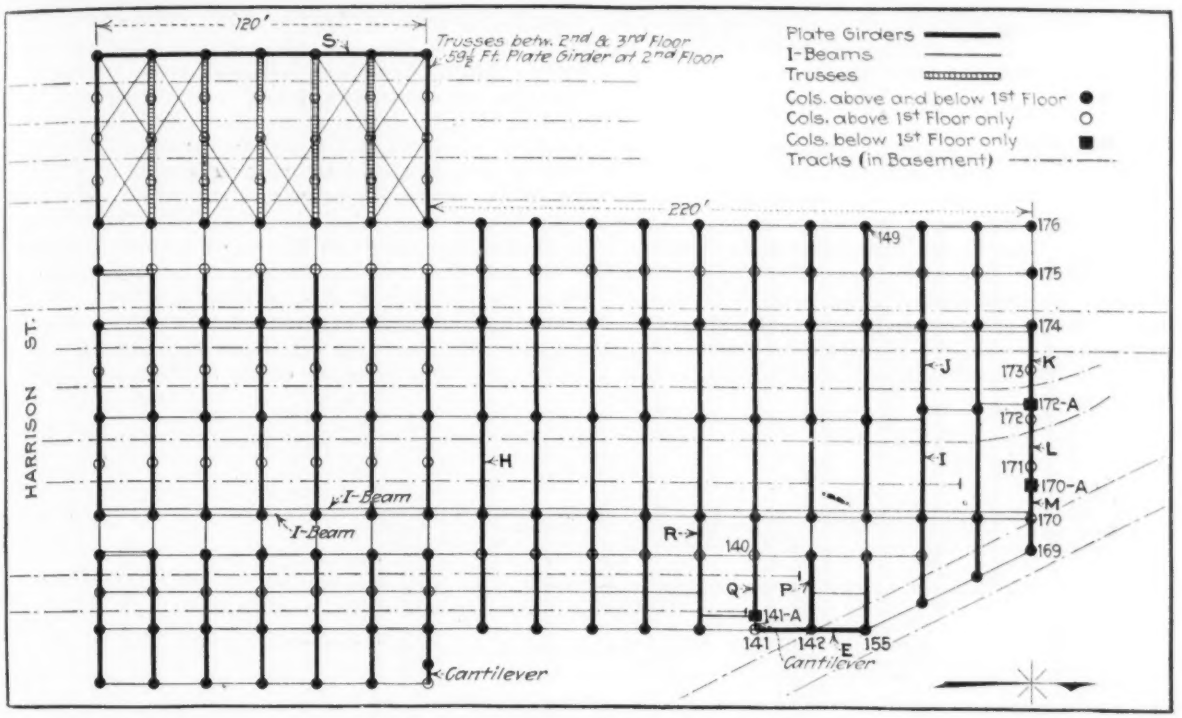


FIG. 2. FRAMING PLAN OF FIRST FLOOR

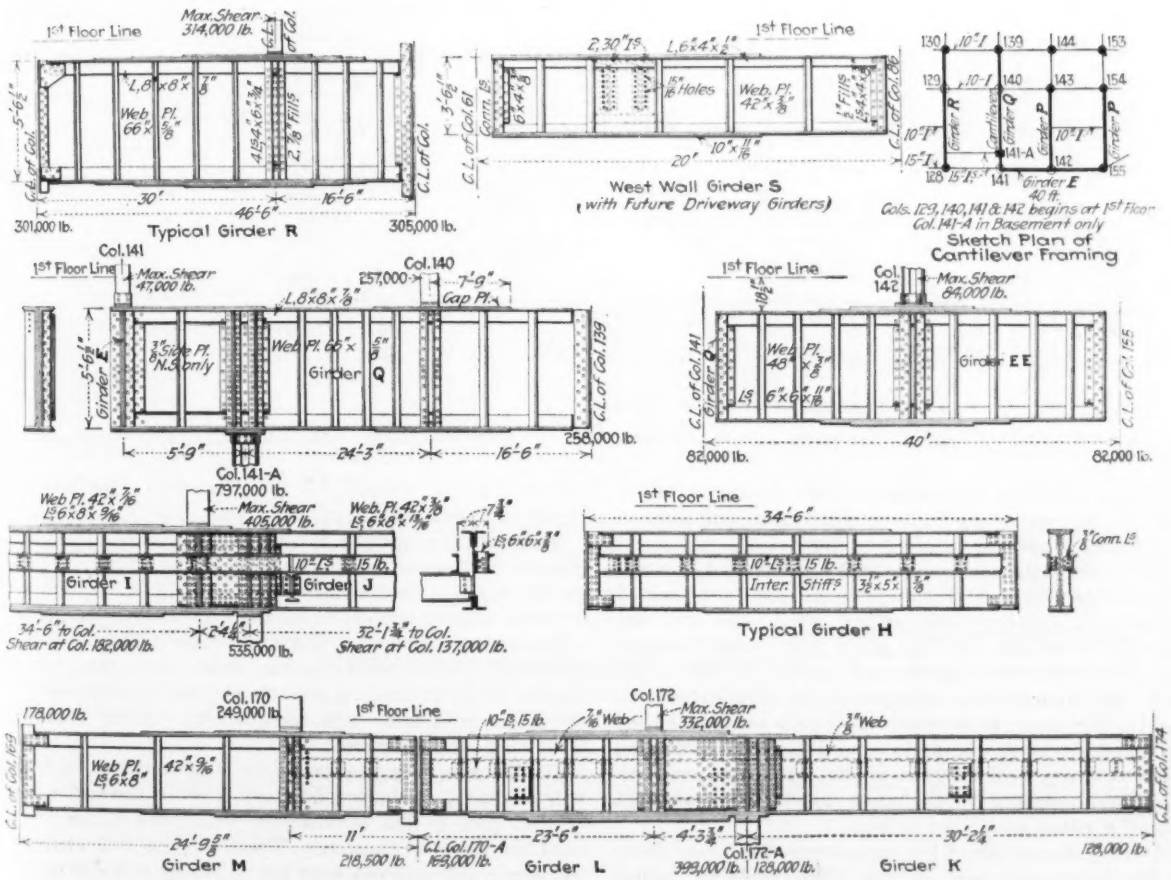


FIG. 3. SPECIAL AND TYPICAL GIRDERS OF FLOOR SYSTEM

railway company's property line. For the east-side driveway there will be single 40-in. girders riveted to the wall columns of the building.

Girders Carry Columns

Unsymmetrical arrangement of columns occurs at several points in the basement, this being necessitated by the track layout and in turn necessitating special arrangements of girders to support the columns of the upper floors. Thus a cantilever girder is required at a point on the east side where two wall columns would obstruct a diagonal track if placed at their normal locations. In the basement or track floor, therefore, one of these columns (No. 141-A, see Figs. 2 and 3) is set back to give the required clearance for cars and upon it is placed a 46½-ft. transverse girder having a cantilever projection of 5¾ ft. to support the wall column in its proper position at the first floor.

The other wall column (No. 142) is omitted entirely in the basement. At the first floor level it is seated on a 40-ft. two-bay wall girder which has one end attached to column and the other end framed against the cantilever girder mentioned above. In the north wall, also, there is an unsymmetrical arrangement to provide for tracks on curves. Here four columns of the basement are so spaced as to clear the tracks and these columns carry girders upon which are seated columns of different spacing for the upper floors. Some of these special girders are shown in Fig. 3.

A truss arrangement for supporting the upper floors in the southwest part of the office building, which extends over the four outer tracks, calls for special attention. Owing to the necessarily close spacing of these tracks it was not practicable to place columns between them. Trusses 59½ ft. long were introduced, therefore, to span these tracks and to support the interior columns for the upper floors. But the trusses could not be placed at the first floor, as the driveways made it necessary to leave this space unobstructed. For this reason the trusses are placed with their lower and upper chords just below the second and third floors respectively, as shown in Fig. 1. To carry this part of the first floor over the track space beneath it, transverse plate girders in two sections are used. Each girder has its outer end riveted to a column which supports the truss and its inner end riveted to a hanger depending from the center of the truss. Horizontal diagonal bracing is introduced to give lateral rigidity to this semi-suspended floor.

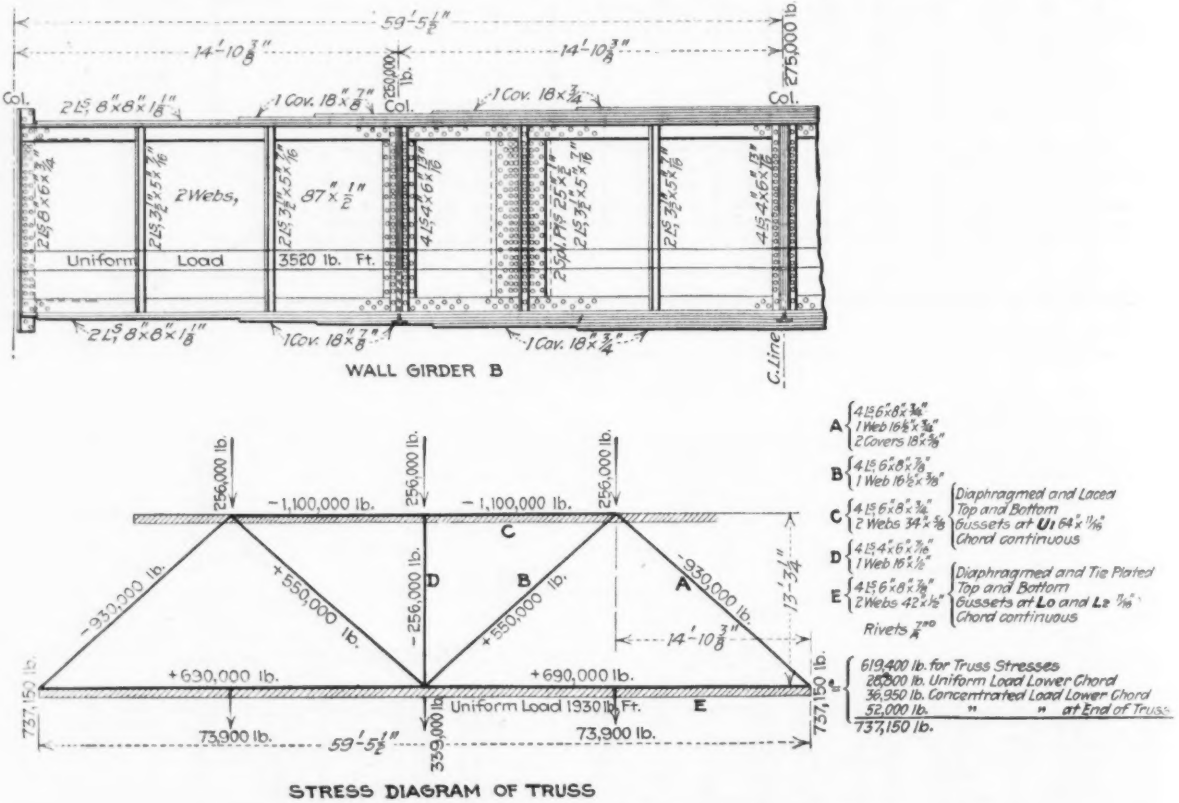


FIG. 4. TRUSSES AND WALL GIRDERS TO SUPPORT UPPER COLUMNS

These trusses are 13¼ ft. deep, with chords of double channel section and web members of I-section. Their dimensions and loading are shown in Fig. 4. Tile fireproofing will be applied to all the truss members, being arranged as shown in Fig. 5. Web plates will be plastered with cement mortar flush with the flange angles, so as to make a smooth surface against which the tiles can be laid. The tile covering will be wrapped with wire and plastered.

Double-web plate girders 87 in. deep and 59½ ft. long will be placed at the second story level in the end walls of that part of the building in which the trusses are used for interior framing. These girders will support the upper wall columns over the driveway and will carry hangers to support the portal framing of the first floor,

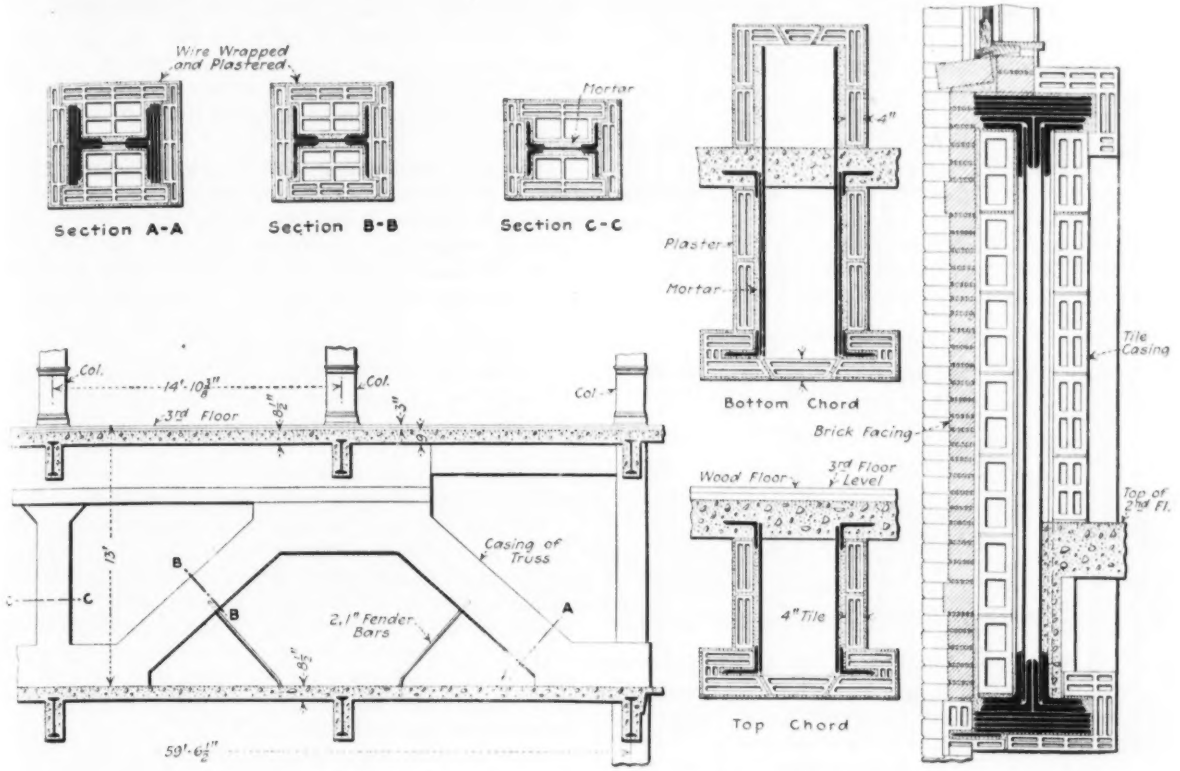


FIG. 5. TRUSS AND GIRDER DETAILS AND FIREPROOFING

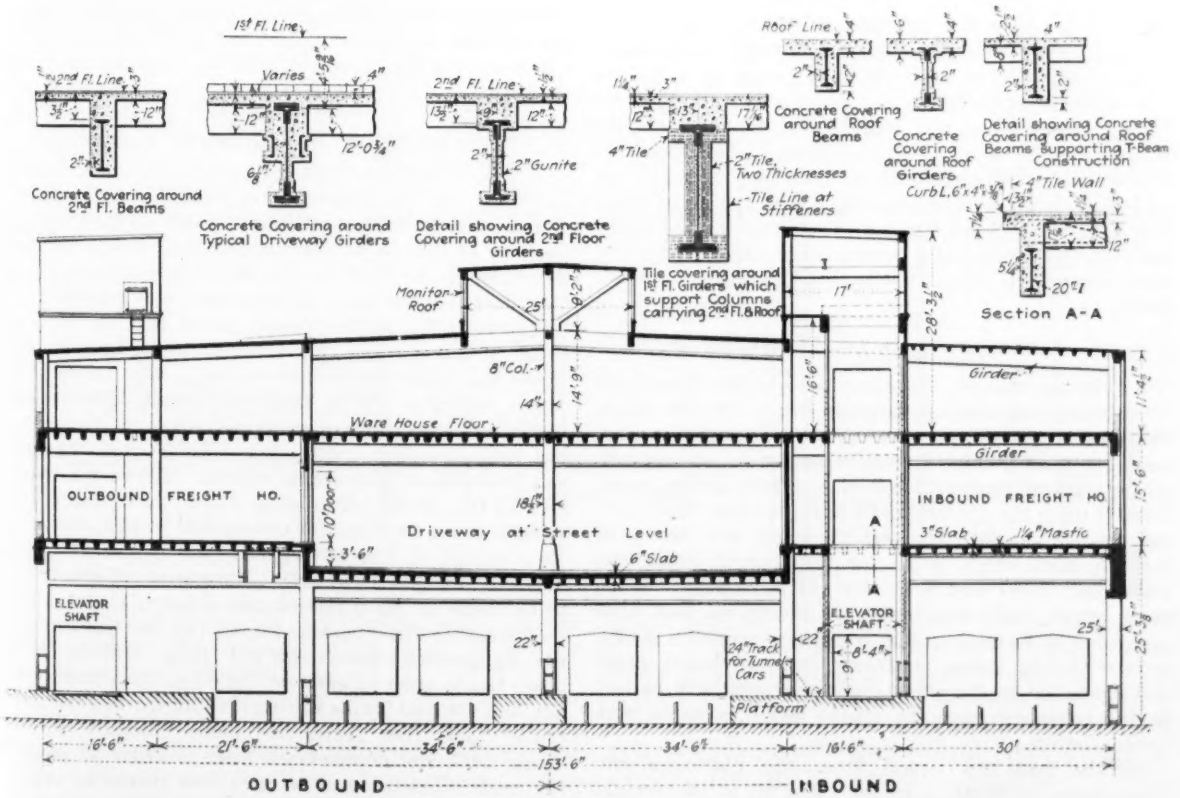


FIG. 6. CROSS-SECTION OF THREE-STORY FREIGHT HOUSE

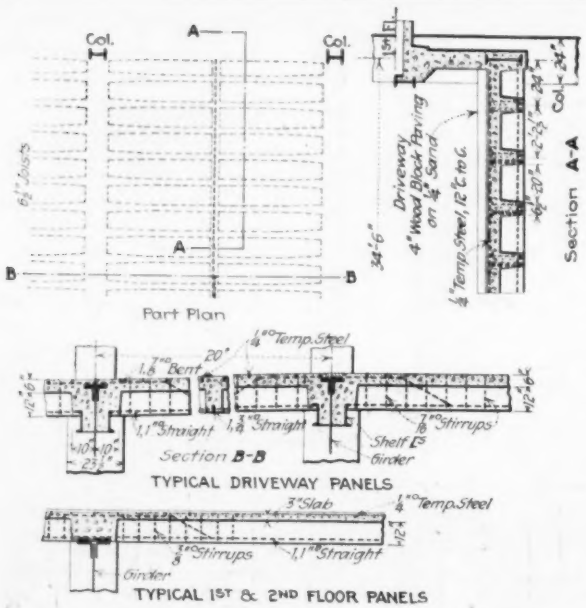


FIG. 7. CONCRETE FLOOR AND DRIVEWAY CONSTRUCTION

across the tracks. Each girder (Fig. 4) will have four cover plates and four flange angles for each chord. The two web plates will not be spaced as far apart as in a box girder, but will be riveted against the T-shaped rib formed by the inner flange angles, the outer flange angles being riveted to the webs. This is shown in the detail, Fig. 5.

Plate girders are introduced extensively throughout the framing of the first and second floors in order to obtain long spans and to eliminate interior columns as far as possible on the floors where freight is handled. A large part of the area will have panels 20 x 34½ ft. The exceptional facilities for driving and trucking on floors, driveways and platforms unobstructed by columns is indicated by Fig. 6, which shows the cross-section of the three-story section of the building. Some of the typical girders are shown in Fig. 3. In the upper office floors there is a closer spacing of columns and the framing is to be largely of I-beams, since there is not the requirement for large unobstructed spaces on these floors.

Concrete Floors and Platforms

Reinforced concrete floors are to be of the ribbed slab or slab-and-joist type, as shown in Fig. 7. In each panel, the ribs or joists extend longitudinally between concrete end beams which are seated on 6-in. shelf channels on the webs of the transverse plate girder or are seated directly upon the girders and I-beams in the framing of the smaller panels. The slab thickness will be 2½ in. for the office floors, 3 in. for the freight house and warehouse floors and 6 in. for the driveways. Wood block paving with 4-in. creosoted blocks on ¼-in. sand cushion is to be used on the driveways, asphaltic mastic on the freight house platforms and warehouse floors and hardwood in the offices. No pavement will be laid on the basement floor, the tracks being ballasted with broken stone.

On the first and second floors, the platforms will have tracks of 24-in. gage for the cars of the freight handling tunnels operated by the Chicago Tunnel Co., as described in the article on p. 728 on the general design of the terminal. A flat slab will be used for the main part of the roof. Live loads used in floor design are 80 lb. per square foot for offices; 200 lb. for office filing space and 300 lb. for the driveways and for the platforms and warehouse floors of the first and second stories.

All steel floor framing is to be cased in concrete having a minimum thickness of two inches, this being placed in forms around the beams and girders. For girders which support columns, however, two layers of 2-in. tile will be used, the web plates being plastered with cement mortar to make a surface flush with the flange angles. Against this mortar the tile will be laid, as in the trusses described above.

Cylinder pier foundations of the type so generally employed in Chicago will support the office section of the building, the concrete piers being built in open wells or caissons sunk to hardpan at an average depth of 60 ft. Timber pile foundations will be used for the three-story warehouse portion of the building.

Freight will be handled between the floors by eleven 2-ton automatic electric elevators 9 x 17 ft. These will require no attendants, but any freight handler can operate them as desired by means of push buttons at the elevator doors. On the outbound platform there will be an elevator in every third or fourth bay and a freight scale in every sixth bay. The inbound platform will have an elevator in every third bay and a scale in every third or fourth bay.

This building was designed under the direction of H. T. Douglas, Jr., chief engineer of the Chicago & Alton R.R., the structural design being prepared by W. F. Rech, bridge engineer. The W. J. Newman Co., Chicago, has the contract for the foundation piers, and the Dwight P. Robinson Co., Chicago, has the contract for the superstructure. The steel work has been fabricated by the American Bridge Co. and is ready for delivery.

Triple-Track Main Lines in France

The addition of a third track to double track lines to facilitate special movements of traffic under war conditions was carried out at several points on the Northern Railway of France, as described in the "Revue Generale des Chemins de Fer" by Mr. Moutier, assistant superintendent. In one case, the new track was especially for military traffic, as the loaded trains had an opposing grade of 1.2 per cent for about seven miles. On this grade the heavy trains moved slowly, thus limiting the traffic capacity. With the third track, the military traffic was kept clear of general traffic and if either of the two ascending tracks should be blocked the other was available to keep traffic moving. Between Lapugny and La Pol, about 16 miles, a third track was laid to provide extra facilities for movements in both directions on a stretch of line having long and severe grades on opposite sides of a summit. Movements of troops had to be made in one direction and a heavy coal traffic in the oppposite direction was imposed on the line owing to the regular route being near the front. Ordinarily, the troop trains were handled on the extra track during the day and the coal trains during the night. Besides these triple track lines there was much doubling of both single-track and double-track lines in order to increase the traffic facilities and to open new routes as alternatives to regular routes threatened by the enemy or given up to military movements.

Multiple-Unit Plan for Compact Factory Plant

Six Steel and Concrete Buildings Form Single Unit —Engineer Handled Design, Machinery Layout and Construction

BUILDINGS of different types and materials for different purposes, but all in contact so as to form practically one structure, instead of being separated by light courts and yards, constitute a noval arrangement in a new bolt and nut forging and galvanising factory at 12th St. and 54th Ave., Chicago. The special purposes of this arrangement are to reduce the area of site required, to minimize the travel of material through the several stages of manufacture and to insure that all movements are made under cover. As the buildings are only one and two stories high, ample light and ventilation of the interior spaces are obtained by extensive window area and large monitor roofs with side lights. The main front of the plant is shown in Fig. 1.

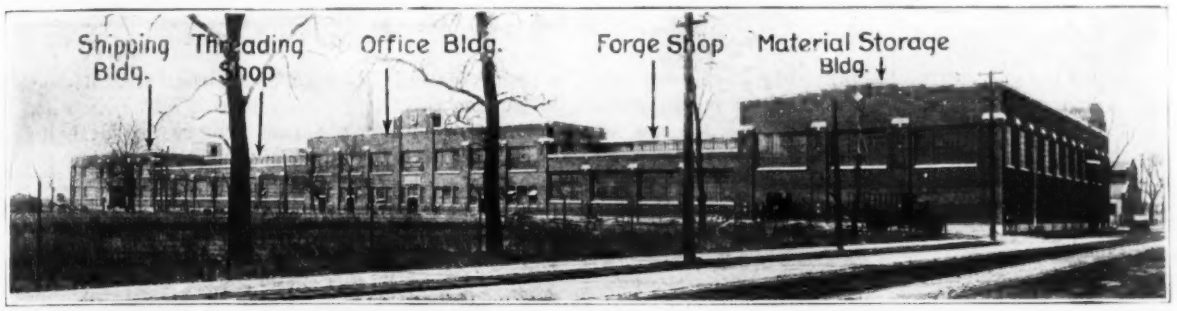


FIG. 1. MAIN FRONT OF FACTORY

steel. Thus a large supply of material was on hand before the work commenced, thus saving considerable expense (in increased prices) and avoiding delays in construction. No general contract was awarded, but separate contracts were let from time to time for the several trades and specialties. Under this arrangement, the engineer acted as general contractor, since it was necessary for him to lay out the work, purchase materials, supervise the various contracts and audit all accounts.

The engineer's work included the design and arrangement of buildings, selection and location of mechanical equipment, special galvanising furnaces using oil fuel, handling of raw material, routing of material in manufacture, shipping facilities, output, power plant and distribution, fuel oil system, heating plant, water and compressed air systems, plumbing and sewerage, conveniences for employees, general and detail plans and specifications, and supervision and inspection of work.

Of the six buildings, Fig. 2, four are one-story steel structures as follows: material storage, 73½ x 188 ft.,

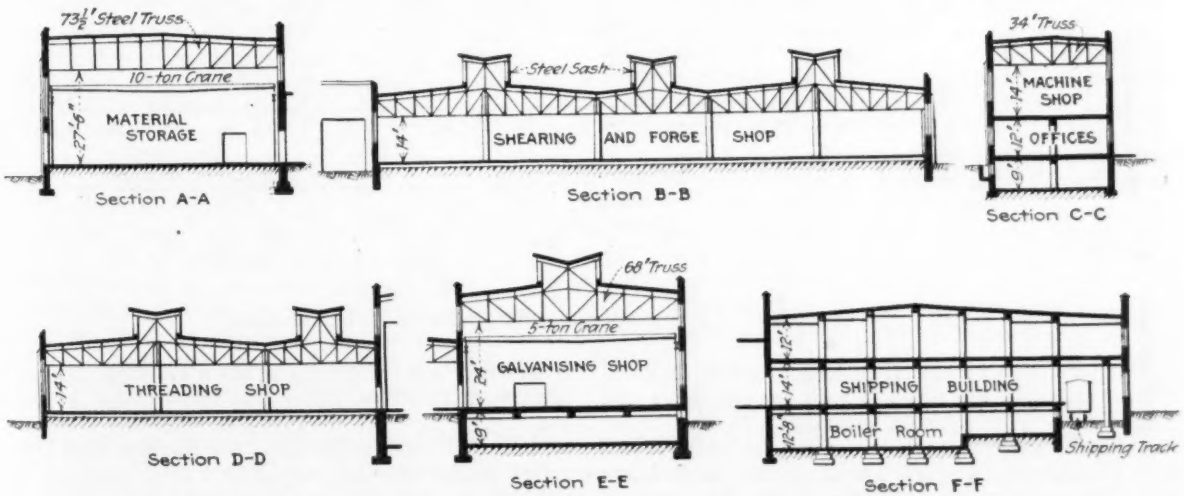


FIG. 2. SIX BUILDINGS FORM UNIT STRUCTURE

A novel feature in the construction was that the engineer supervised the construction by contractors, no general contract being let.

At the time the plans were being prepared it was evident that the prices of building materials were on the increase. The engineer, therefore, secured the consent of the owner to purchase for immediate delivery the sand, stone, cement, lumber, brick and reinforcing with 73½-ft. roof trusses; shearing and forge shop, 160 x 171 ft., five bays of steel trusses; threading, nut and assembly building, 102 x 200 ft., three bays of roof trusses; galvanizing building, 68 x 200 ft., with 68-ft. roof trusses. The shipping building, 128 x 200 ft., and the combined office building and machine shop, 34 x 140 ft., are reinforced-concrete structures with two stories and basement. Their upper floors are designed

for a load of 250 lb. per square foot. Typical sections are shown in Fig. 3. All the buildings are faced with buff brick, and white terra cotta. Brick floors are used in the shops.

Steel and Concrete Buildings

In the steel buildings the principal features are the high and wide monitor roofs, the sides of which are filled entirely with wire glass in fixed or pivoted sash. The roof of the monitor is of the butterfly type, thus giving maximum height of face without obstruction of light by eaves and gutters as in the case of roofs of the umbrella type. Further, all drainage is taken care of by interior pipes instead of by exterior downspouts.

Typical truss construction is shown by the details of roof of the galvanizing building, Fig. 3. The chords and web members are of T-section, built up of pairs of angles. The truss spacing is 20 ft. Upon the top chords are purlins of I-beams and channels, supporting a cement tile roof which is covered with felt and gravel roofing. All columns are of H-section.

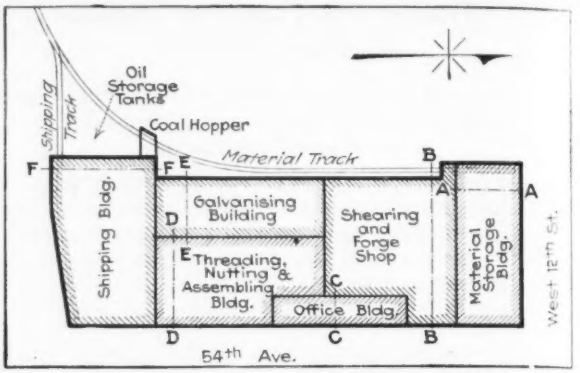


FIG. 3. SECTIONS OF FACTORY BUILDINGS

a 10-ton traveling crane which either stacks it or delivers it to the forge shop. In this latter shop and in the threading shop the roof trusses are designed to carry all shafting, piping, air ducts and motors, so as to give a clear headroom between the floor and the bottom chords of the trusses. The galvanizing building

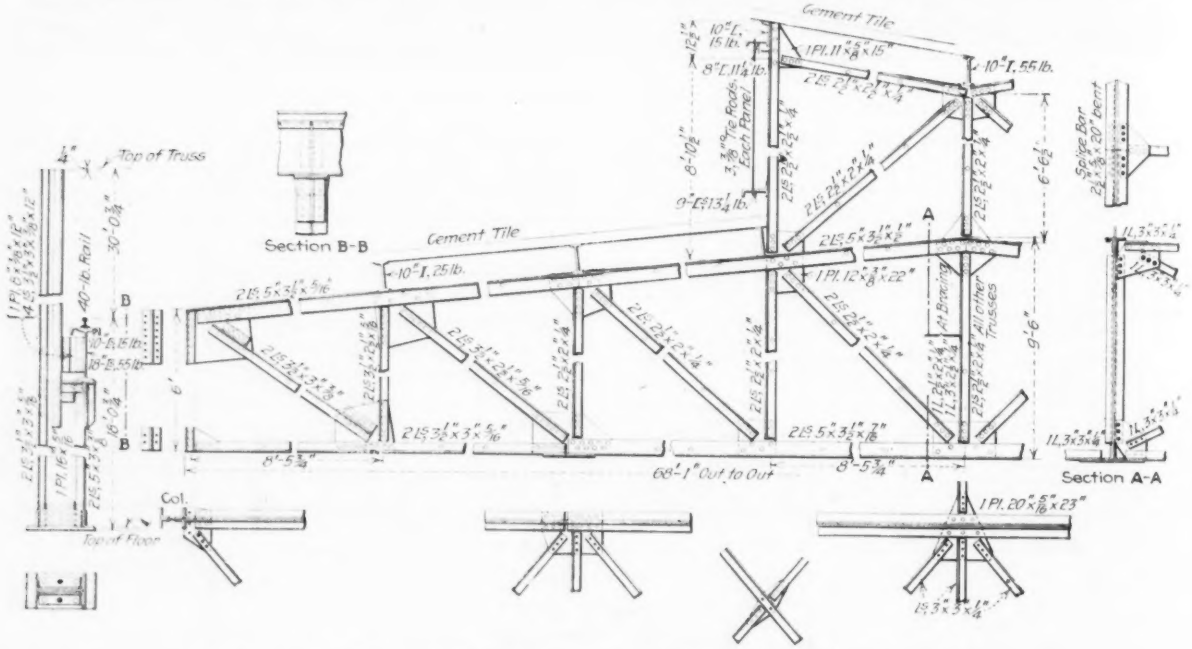


FIG. 4. TYPICAL STEEL ROOF CONSTRUCTION (GALVANIZING BUILDING)

Beam and slab construction, with two-way diagonal reinforcement in the slabs, is used for the floors and roofs of the two concrete buildings. In the larger shipping building the panels are mainly 16 x 17 ft., with 7½-in. slabs. A single row of columns in the lower part of the smaller office building divides the area into panels 17 x 20 ft., but the upper or machine shop floor is unobstructed, as it is spanned by steel trusses carried on brick pilasters.

Engineer Plans Equipment

The variety of matters to be considered by the engineer in the design of the plant, apart from the selection of manufacturing machinery, may be judged from the following notes of the equipment. Material received by car or wagon at the storage building is unloaded by is served by a 5-ton crane and has a basement for storage. General offices, locker and toilet rooms, hospital and filing space are arranged on the first floor and basement of the office building, the machine shop being on the second floor and served by a 5-ton elevator. In the shipping building is a depressed track so that the floors of cars are level with the floor of the building. Two elevators and a spiral chute for descending packages are provided. The first floor is for assembly and shipping, with the basement and second floor for storage.

Electric operation is used throughout, current at 2,200 volts being delivered to a substation on the roof of the shipping building, where it is transformed to 440 volts. In the basement is the main switchboard, together with three boilers for the vacuum return heating system.

Coal is delivered to a track hopper; ashes are removed by a skip hoist and dumped into cars. Fuel oil is unloaded from cars by gravity or by pumping and is stored in four underground steel tanks having a combined capacity of 75,000 gal.; all control valves are inside the building. Distribution is by pumping to overhead pipes, heaters being provided for the pumps and tanks. Meters are provided on the oil distribution and return pipes.

Cooling water is required in considerable quantity for the forge shop, but as it would be too expensive to secure this from the city supply or to drill a special well, it was decided to use a circulation system. The used water is drained to an underground settling basin and pumped to cooling tanks on the roof, whence it returns to the circulating pipes, any necessary make-up water being taken from the city main. This system is designed for a maximum supply of 600 gal. per minute.

Compressed air for the boiler burners and the forges is supplied at 1½-lb. pressure by three motor driven compressors in the boiler room, the blast ducts being carried in the bottom chords of the roof trusses. Sulphuric acid for the galvanizing process is delivered by an air pressure from tank cars to two vertical steel tanks of 15,000 gal. combined capacity, with gravity supply to the working room.

This factory was designed, built and equipped for Hubbard & Co., by J. L. McConnell, consulting engineer, Chicago. Construction was commenced Nov. 1, 1919, and the entire plant was completed by June 1, 1920.

Mesh Reinforcement in California Concrete Pavements

ON COUNTY highway work in California the use of mesh reinforcing in concrete pavements has been rapidly increasing. To date about 300,000 sq.yd. of mesh reinforcing for county road work has been supplied in that state by one firm alone and the demand during the first eight months of this year was for three times the amount supplied last year. In general it is true among county engineers of California that where sufficient funds are available to permit its use there is no discussion as to the desirability of reinforcing, the only question being as to the most suitable kind and weight, its cost and the best method of placing it. In next season's road construction program the counties are planning more extensive use of mesh reinforcing. This means much in California because in that state last year fourteen counties voted a total of $20,604,000 for road bonds. Of this work 50 per cent is now under way and about 90 per cent will be paved.

Where mesh is used the amount varies from 22 lb. per 100 sq.ft. as a minimum to 41 lb. as a maximum, the average being about 26½ lb. About 26 or 27 lb. per 100 sq.ft. is believed to be sufficient to prevent longitudinal cracks and control the transverse cracks so that they have no injurious effect. In the method now preferred the fabric is laid with the longitudinal wires at right angles to the center line of the road. By giving the mesh a small lap on each width to insure bond, reinforcement is secured in both directions.

In general, three methods have been used for handling and placing the mesh. In the first, the mesh is placed directly upon the prepared sub-base, the concrete is poured upon it and the mesh is then pulled into the center of the slab with hooks. In the second method the mesh is placed upon sections of pipe laid on the sub-base lengthwise with the road. The pipes serve to keep the mesh in the center of the slab during the process of pouring, after which the pipes are withdrawn. A third plan, known as the two-operation method has not yet been used extensively but has thus far met with considerable success.

In the two-operation method the mesh is shipped to the job in flat sheets cut to the proper length. Mixing operations are then begun and the lower half of the slab is poured for a convenient length (section one). Where a spout mixer is used this first pouring is from the end of the spout. A gate in the middle of the spout is then opened and the space next the mixer (section two) is poured on the sub-base in the same manner. During this second operation the fabric is laid on section one and, without moving the mixer, the top half of section one is poured over the mesh from the outer end of the spout.

The mixer is then advanced a distance equal to the length of a section and while the lower half of section three is being poured from the gate in the middle of the spout, sheets of fabric are laid over the lower half of section two. The gate in the middle of the spout is then closed and the fabric of section two is covered with its top layer of concrete by pouring from the end of the spout. This process is repeated during the remainder of the job, two adjoining sections of half thickness, one at the top and one below being poured from each mixer position.

Advantages claimed for this scheme of placing are: the mesh is kept properly in the center of the slab, reinforcement does not have to be disturbed after it is once in place and pouring operations are interfered with to a very limited extent. This method was used by R. M. Morton, while engineer of the Sacramento County Highway Commission, to whom we are indebted for the following cost data.

On Sacramento County work the mesh used weighed 27 lb. per 100 sq.ft. and cost $1.53 per 100 sq.ft. delivered. Two men per gang were employed to handle and place the reinforcing. When laying 7,500 sq.ft. of pavement per day the cost of hauling and placing the mesh was 35 cents per 100 sq.ft. This cost includes a slight charge against the reinforcement for a slowing up of mixer operations. The total cost of reinforcement in place on this job was therefore $1.88 per 100 sq.ft., making a cost per mile of $1,566 for a 15-ft. roadway.

Progress on Shandaken Tunnel

Progress on the construction of the Shandaken tunnel of the Catskill water supply system for New York City was continued during 1919 and at the year's end, according to the latest annual report of J. Waldo Smith, chief engineer, all but one of the eight shafts had been completed and the tunnel heads turned. During the year 2,356 lin.ft. of shaft were sunk and 1,098 ft. of tunnel were driven. In connection with this work a transmission-line for the purpose of furnishing electrical energy to the various parts of the project was constructed from a point near Kingston to the intake shaft at the Schoharie reservoir, a total distance of 50 miles.

Industrial Wastes in Relation to Water Supplies

Abstract of a paper presented before the Sanitary Engineering Section of the American Public Health Association by W. Donaldson of Fuller & McClintock, New York City.

IT IS the history of industrial pollution of water that the nuisance and damage is brought into existence before remedial measures have begun to be applied. Although the problems of trade waste are not new to this country, certain results of the Great War, such as the building up of large urban populations and the remarkable quickening of industrial life, have greatly increased their importance. Already we witness some of the most important rivers so grossly polluted with industrial waste as to be hopeless of reclamation for water supply purposes.

The importance of preserving the purity of the streams and lakes of the United States is evident from the fact that probably at least 40 per cent of the entire population of this country is supplied with water from surface sources.

The effect of industrial waste on public water supplies is generally manifested in one or more of three ways: First, disagreeable odors and taste; second, foreign substances which make the water unsuitable for use or interfere with the functioning of purification work and, third, chemical substances in solution which may cause actual damage to water work structures or render the water less fit for domestic or industrial use. It is not surprising to note that often it is the principal or basic industries of the country which are responsible for water pollution.

Acid Wastes Damage Structures

Coal mine wastes which merely blacken the stream waters are, generally speaking, not serious because they are easily removed by the sedimentation and filtration processes. Acid wastes, however, which commonly drain from coal measures when exposed to the atmosphere may so strongly impregnate the waters as to make them unsuitable for either domestic or industrial use. Along the Monongahela River acid wastes are blamed for many thousands of dollars worth of damage to structures of the government dams and to shipping. Although the cost of treatment is a considerable factor, water purification plants on this stream are able to neutralize the acid effect by means of lime or soda ash treatment in connection with a filtration process before delivering water to the city main. There is, too, the claim that in the Pittsburgh district, for example, the wastes are not wholly detrimental in the streams, for they serve to sterilize the considerable sewage pollution and thus have protected from water-borne diseases many of the communities taking their water supply the stream without filtration.

The rapid increase in recent years of producer gas plants and by-product coke works has added materially to the problems of water supply by reason of the phenol and its derivatives found in the waste products from such plants and which persist in the water by reason of their relative solubility. Phenol waste usually acts indirectly by reason of the facilities with which phenols form substitute compounds with chlorine gas and calcium hypochlorite, which are in general use for water sterilization in this country. Substitution compounds so formed have odor and taste very much more intensive than the original unchlorinated substances which themselves might exist in water in high dilution without being noticed. Instances are on record of phenol attacking the oil preservative used on water pipes in such way that the result was the intensively aromatic tri-chloral-phenol.

The taste of treated water taken from Lake Michigan was traced to phenol waste after it was found that the intensity of taste did not depend upon the amount of chlorine used for sterilization but upon the amount of phenols present in the water. Often the taste is attributed solely to the sterilizing agent when in fact the real cause is the action of phenol waste on that agent. Another unfortunate effect due to the presence of phenol wastes is their effect of reducing or nullifying the efficiency of the chlorination process used as a safeguard against harmful bacteria. In numerous cases where phenols were present it has been impossible to get satisfactory bacterial reduction, except by excessive doses of chlorine and resulting disagreeable taste.

Ordinary processes of water purification have not been successful with phenol waste, but some recent experiments indicate the possibility of affecting a considerable removal before chlorination and thus reducing the probability of complaints from taste and the interference with chlorination as noted in the foregoing. (Other trade wastes which the paper discusses include oil-well operations, and wastes from oil refineries, tanneries, and wood distillation or paper industries.)

It can hardly be denied that the prosperity of a nation is fairly measured by its industrial development. It is obvious, therefore, that the proper solution of the problems of water pollution by industrial wastes does not lie in the forbidding of industry, but in a sane regulation whereby industries may flourish without detriment to the resources of the country. It is proper that the burden of preventing stream pollution should be placed on the industrial plants themselves. There has been too much carelessness by manufacturers in allowing obnoxious waste to enter streams, and too much disregard of the right of others, particularly the public, in the use of streams. The manufacturer often can, with little expense, prevent the pollution of streams and repeatedly it has been found that the unwilling adoption of a process for waste disposal has resulted in a clear profit to the manufacturer in the recovery of by-products.

On the other hand, it is apparent that the necessities of public water supplies have some times borne down rather heavily upon the industries, when remedies were at hand for offsetting the effects complained of. It must be admitted that water purification plants are very much sterotyped in design and fitted only for handling the older problems of removing sewage effects. In these matters it would seem that the "rule of reason" might often be put into effect, although it must be admitted that the structure of American law is not inclined much to the principle of "balance of conveniences."

Florida's Average Elevation

The highest point in Florida whose altitude has been determined is Iron Mountain, in Polk County, which stands 325 ft. above sea level, according to the United States Geological Survey, Department of the Interior. The average elevation of the state as computed by the Geological Survey is about 100 ft.

British Labor's Political Activity—An Editorial View

THE following paragraphs from an editorial in *The Engineer*, London, Sept. 10, have an interest for American readers because of tendencies in this country:

There are few indeed of our readers who will not agree with us that the most sinister aspect of recent labor movements is their political bearing. It is a growth of only a few years, and its origin may be traced to the first occasion on which the Government of the day intervened in a labor dispute. The whole status of the trades unions was changed by that untoward event. The foundations of their political power were greatly strengthened. Strikes, which before that time were business affairs between employers and and employed, became national affairs, for it was always in the power of labor to embroil Cabinets by extending the bounds of the dispute. It was only necessary for a strike or dispute to assume sufficiently large proportions to force the Government to intervene, and as intervention always meant compromise the unions were invariably the gainers. Hence we may say that the formidable proportions of the strikes of today are attributable directly to the interference or intervention of Governments in trade disputes. Many leaders of thought foresaw the danger. They perceived that the labor vote would gain a new and dangerous influence; that Cabinets, subject to a score of diverse forces, would be weaker than unions with a single object in view; and that small local affairs would be raised to the first magnitude by the solicitousness of Parliament. This is a non-political paper and we write with no political bias, but merely state a familiar fact when we say that one politician—the present Prime Minister—is more greatly responsible for the present condition than any other man in the kingdom. With a genuine desire to serve a class of the community which he believed stood in need of help he was led step by step from action to action, which gave ever increasing power to that section and has at length raised it to a position when it dares to defy the Cabinet, the country, and the constitution.

It may be doubted if there is any escape from the position to which the industrial affairs of the country have been brought. It may be doubted if ever again the country will be free from the menace of national strike. It may be doubted if ever again labor will be unable to daunt Governments. But if it be impossible to take from labor the lever which a mistaken policy has placed in its hands, it is still, fortunately, within the power of the country to see that it is not allowed to wield that lever with the indiscriminating mischief of a giant. We have not the least desire to see the trades unions crushed, for we recognize fully the good that they have done and the good they can do. But we do desire to see their powers restrained within appropriate bounds, and we wish above all to see their political influence destroyed. There is no parallel to them in the country, no body of men that can hold the kingdom to ransom for its own ends. They enjoy a power which was never anticipated, for they are able to upset the basal principles of democracy and to make the minority more powerful than the majority. It is against that we have to fight.

Chicago Buys Coal on B.T.U. Basis

Coal for the city of Chicago has been purchased for some time by competition bid on the B.t.u. basis adjusted within definite limits for the percentage of ash. The contractor in his bid offers so many B.t.u. for 1c. In the ash adjustment for coal, which by analysis contains less than a specified percentage of ash, a premium of 2c. per ton for each whole per cent is paid. An increase in the ash content of 2 per cent over the percentage of ash specified is tolerated, but for that which contains more than 2 per cent the penalty is 2, 4, 7, 12, 18 and 25c. per ton for each succeeding per cent of excess and 35c. for each ton that contains 8 per cent in excess of the percentage specified.

Digging Niagara's New Power Canal

THE airplane view herewith shows the stage of construction of the earth cut of the Queenston-Chippawa power canal in June of this year. This canal, as described in *Engineering News-Record*, Dec. 11-18, 1919, p. 1,010, is to carry 10,000 sec.ft. around Niagara Falls for the development of 300,000 hp. at a power-house below the rapids on the Niagara River. It is being built by the Hydro-electric Power Commission of Ontario on force account.

The section shown is in the earth cut at about Sta. 240 and is looking upstream toward the Welland River connection out of the view toward the left. In the foreground the full earth section, about 60 ft. deep and 160 ft. wide at the top and 70 ft. wide at the bottom, has been completed and preparations are under way for the rock drills which are approaching from below but have not yet entered the field of view of the camera. A rock cut 48 ft. wide and approximately 60 ft. deep is yet to be made here Beyond the bridge over the canal is working one of the 8-yd. electric steam shovels—which with their 63-ft. dipper lift are the largest in the world. This is removing the main earth section, which has been stripped by smaller shovels, and is emptying into the spoil tram which can be seen running on the parallel tracks.

AIRPLANE VIEW OF QUEENSTON-CHIPPAWA POWER CANAL UNDER CONSTRUCTION

Rivets on Structural Steel Jobs Heated by Gas

Gas instead of crude oil or coke is being used for heating rivets on some structural steel jobs on the Pacific Coast. The custom has come into vogue following the use of gas for this purpose in shipyards.

Design of the New Canadian Niagara Power Project

Fundamentals Which Controlled the Design and Description of the Installation of the Queenston-Chippawa Hydraulic Development of the Ontario Power Commission

FOR about three years the Hydro-Electric Power Commission of Ontario has had under construction around Niagara Falls a water-power development which will utilize nearly the full drop between the two lakes and require for maximum capacity practically all of the flow now permitted Canada under the international agreement. The present scheme contemplates the development of 500,000 hp. at 305 ft. head, using ten 50,000 hp. turbines, five of which have already been ordered. The scheme, known as the Queenston-Chippawa Development, is by far the biggest power project under way today, but although there have been numerous descriptions of its general features, notably in this journal, there have never been published any of the fundamentals which governed the design nor have the details of the remarkable power house installation been published. At the recent professional meeting of the Engineering Institute of Canada, members of the staff of the power Commission delivered papers which covered hitherto unrevealed details of the work. From these papers the following matter has been gathered. The authors of the papers are H. G. Acres, hydraulic engineer; T. H. Hogg, assistant hydraulic engineer, and M. V. Sauer, hydraulic engineer of design.

The Queenston-Chippawa project takes water from the Niagara River about 1½ miles above the Falls and delivers it through a canalized river and dug canal, a total distance of 13½ miles, to a power house under the bluff on the lower river 5 miles below the Falls. The upper 4½ miles of the channel is in the Welland River, whose flow is reversed for that distance, and the canal section, partly through rock and partly in earth cut, is 8½ miles long. The design and particularly the economics of the canal were described as follows by Mr. Hogg:

The canal is divided into four sections. The first of these is the Welland River section 21,000 ft. in length, with a bottom slope 0.000119 and side slopes of 2 to 1. The earth section which follows the river section is 6,250 ft. long with a bottom slope of 0.0001208 and is to be riprap with finished side slopes of 1.5 to 1. For each of these sections a roughness factor of 0.0035 in Kutter's formula was used. The earth section of the canal was originally designed as a concrete lined section of much smaller cross-sectional area but a study of the economic, constructional and operating conditions indicated the advantages of the larger section with the riprap lining would be sufficient to compensate for the cost of the extra excavation. This portion of the canal has a capacity of over 15,000 sec.ft. with uniform flow at the assumed roughness factor of 0.035, and extreme low water in the Niagara River at Chippawa.

At the end of the earth section is located a transition 300 ft. long in which the trapezoidal cross-section is changed to the rectangular rock section of 48 ft. finished width with concrete sides and bottom. Beyond this are the control works.

The rock section proper is 36,252 ft. long and is divided into two parts by the Whirlpool section, which has a length, including transition, of 2,450 ft. The rock portion of the canal has the water section with concrete-lined sides and bottom with a finished width of 48 ft. The bottom slope is 0.0002113 and the roughness factor used in Kutter's formula 0.014. This value is conservative in view of the proposed method of placing the concrete lining. With the steel forms that are to be used and the special provisions being made for alignment of the forms, a smooth plane surface will be obtained on the concrete facing.

For 13,500 ft. the concrete lining will be carried up 32 ft. above the finished grade of the canal, for the next 11,500 ft. the lining will be 31 ft. high and for the remainder 30 ft. high, except in the Whirlpool section where it is carried up slightly higher. For the greater part of the time the water surface will be above the top of this concrete lining but the friction loss will be reduced by the lower velocities that will then exist in spite of the greater roughness of the unlined rock. Numerous hydraulic studies have been made to determine the surface slopes in the canal for various discharges and for various water levels in the Niagara River. In cases where the water surface was above the top of the concrete lining a composite roughness factor was used in which the proportions of the wetted perimeter on the lining and on the rock surface were taken into account. Roughness factors as high as 0.019 resulted in some of these instances.

Determination of Depth and Slope

The depth and slope of the rock section were fixed by an economy study and the decision to use a concrete lining throughout its length was also reached in the same way. The method of arriving at the economic section of the canal will be explained later.

The rock surface falls far below the grade of the canal in the Whirlpool section. Here it is necessary to carry the canal partly on fill and to use a trapezoidal cross-section on account of the foundation upon which the canal is carried. A concrete lining is essential on account of the high velocities. The bottom width is 10 ft. and the side slopes 1½ to 1. The slope of the bottom is the same as that of the rock section, viz., 0.0002113.

The Whirlpool section of the canal was designed to have the same cross-sectional area at the lowest possible operating water level as that of the rectangular rock section. This minimum water level would be somewhat above the elevation of the curtain wall at the screen house. The area of the cross-section below this elevation is the same for both, and for greater elevations the Whirlpool section has the greater area so that there is no danger of the canal capacity being "choked off" at this point.

In locating the Welland River section the river course was closely followed ,so as to take advantage of the area of the natural channel. This necessitated leaving in all the bends that occurred in the unimproved stream. As the deflection of these curves is not great they will not produce any appreciable loss.

The first important change in direction occurs at the beginning of the earth section at Montrose and is followed by a second bend at the Michigan Central R.R. crossing at Montrose. In addition to these there are only five changes of direction in the rock section of the canal, the deflections of which are 51 deg. 27 deg., 31 deg., 33 deg. and 46 deg. The radius of curvature in every case is 300 ft. and this radius is used for the inside and outside of the bend as well as for the center line. That is, the curves of the two sides and the center line of the canal are not concentric, resulting in a greater width of canal at the middle of the bend than at either end, the expectation being that the energy losses will be less than in a bend with concentric curves. It is probable that a shorter radius than 300 ft. would give even better results, but this minimum was fixed by the size of the electric shovels that are being used for the excavation of canal.

The question of surges of the water surface in the canal, due to changes of load on the plant, is of great importance. This problem has received an amount of study proportionate to its importance, but on account of the limited space of this paper, it will be sufficient to say that the sides of

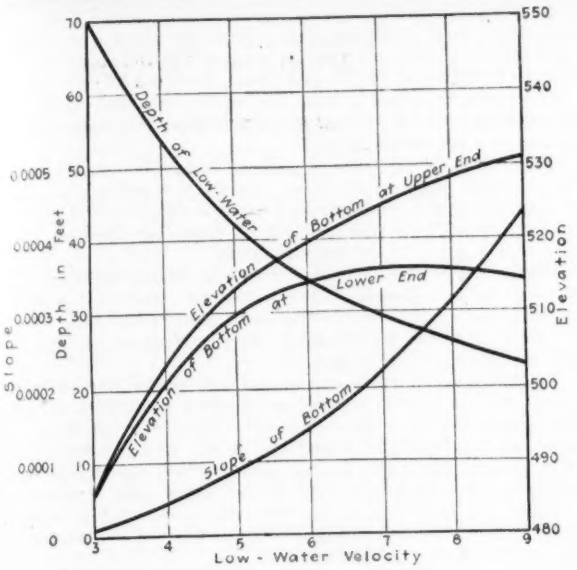


Fig. 1. Variable Functions of Canal.

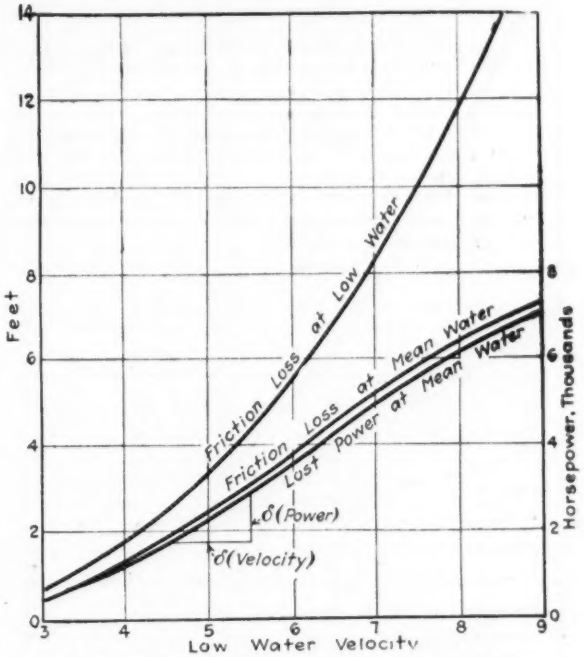


Fig. 2. Friction Loss and Lost Power Due to Friction.

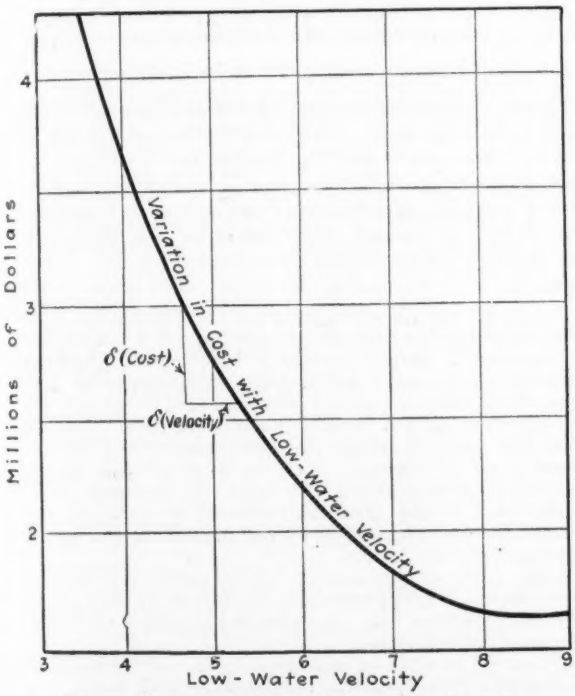


Fig. 3. Variation in Cost with Low Water Velocity.

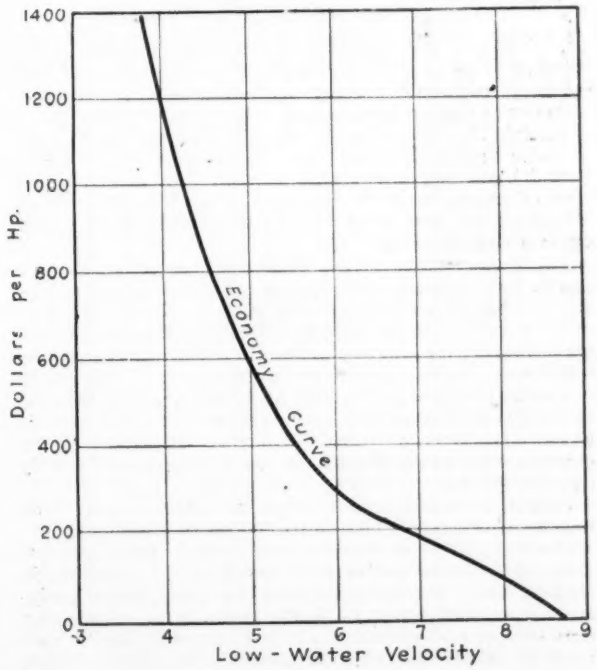


Fig. 4. Economy Curve.

FIGS. 1 TO 4. PROGRESSIVE CURVES IN ECONOMIC STUDY OF A ROCK-SECTION POWER CANAL

the canal and the floor of the screen house will be built to such an elevation that with the worst combination of conditions the water will always be contained within the sides of the canal.

Observations of river stage at Chippawa have been available since 1902 and show a minimum elevation of 558.5, which low stage was reached only on two days. An examination of the past records of Lake Erie stage indicate that as low a stage as 558 may be possible at Chippawa. This latter water level is therefore treated as extreme low water and the canal is designed to carry full load at this stage of the river.

While the low-water conditions control the size and slopes of the canal, on the other hand the mean water conditions were assumed to be those on which the economic proportions should be based.

Certain limitations were met with at the outset. The Welland River section of the canal had to be maintained as a navigable stream, and as the excavation is in earth this portion of the canal was therefore designed for a low non-scouring velocity. The minimum width of the rock section was fixed by the type of electric shovel used for excavating this portion of the canal and was placed at 48 ft.

The problem thus resolved itself into selecting the best proportions for the trapezoidal earth section and the best

depth and slope for the 48-ft. wide rock section. The procedure in the latter case is the one that will be described.

It is, of course, possible to design any number of canals 48 ft. wide, but with depth and slope varying so that all will give the same discharge at low water. For a low velocity the wetted cross-section must be deep but its slope may be moderate. For a high velocity the depth of the wetted cross-section will be small but the slope may be so great that the depth of the cut at the downstream end may be greater and the total cost of excavating greater than for the low velocity design.

The procedure in determining the economic depth was as follows:

First, the design of a number of cross-sections for velocities of 3, 4, 5, etc., feet per sec., the determination of the requisite slope of the bed in each case to give the full load discharge with uniform flow, and the determination of the variation in cost of these canals with low-water velocity.

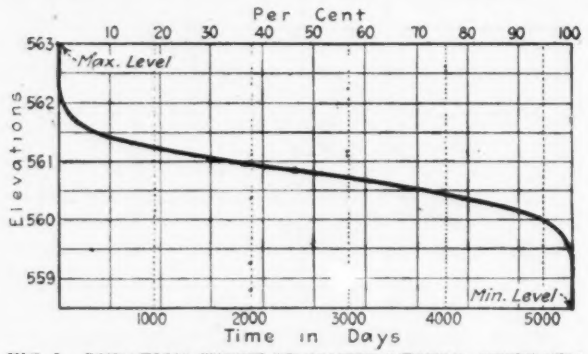


FIG. 5. DURATION CURVE OF WATER LEVELS, CHIPPAWA GAGE, UPPER NIAGARA RIVER, 1902-16

Second, the determination of the friction loss in each of these canals with the river stage at its mean value. This friction loss represented so much lost power, which was, of course, small in amount for the lesser low-water velocities, and greater as the low-water velocity increased up to a certain point.

Third, the plotting of the differential curves for items 1 and 2, thus showing the variation in delta cost with low-water velocity and the variation in delta power with low-water velocity. From these two differential curves a third curve can thus be obtained giving the value of delta-cost by delta-power plotted against low-water velocity. Thus there is obtained what will be called an economy curve, showing for any given low-water velocity the rate at which further gains in power may be made at any low-water velocity by enlarging the canal slightly and so cutting down velocity and friction loss

Fourth, the selection of the best low-water velocity from this economy curve. This step will now be explained.

The gain in power which results from a slight enlargement of the canal comes as a result of the reduction in friction loss. The additional cost for power-house equipment is so small, within the limits in which we are working, that they can be neglected. It is reasonable then to continue the enlargement of the canal until the interest charges on the cost of excavation for the last horsepower gained are equal to the average value of the power from the whole plant, including interest, depreciation, operation and maintenance. By stopping short of this point we would be in a position to gain more power at a cost less than the average that we were willing to pay for the power from the whole plant. It is interesting to note that the economic velocity determined in this way is but slightly greater than the minimum cost at which the canal could be built to get the required discharge at low water. The minimum cost occurs for a velocity somewhat greater than the economic velocity.

The advantage for this method of attack is that it permits an economic size to be selected for the canal without the inclusion in the estimate of the cost of anything that does not vary with the low-water velocity. In this case the width of the rock cut being fixed the earth excavation does not vary with the various designs for the rock section and as a matter of fact in computing the cost of rock excavation only that below some assumed horizontal plane at a lower elevation than natural rock surface but above canal grade was considered.

Figs. 1 to 4 illustrate a typical economic canal study. The studies from which these figures are taken were for a canal of smaller capacity and greater roughness than the one being built so that the curves show the method only and do not apply to the present canal.

Fig. 1 shows the results obtained in designing for various low-water velocities. These designs can be made only when a previous study for the earth section has been completed so that the elevation of water surface at the end of the earth section is known.

Fig. 2 shows friction losses and lost power due to friction. The method of obtaining the first derivative of the lost power curve is also indicated. Only the variation in cost, not total cost, is shown in Fig. 3. It is evident that the shape of this curve is the same whether we include the whole cost or only that part which varies with low-water velocity. In either case the first derivative will have the same value. The determination of the form of the economy curve, Fig. 4, is explained above.

The procedure in the economic design of the earth section of the canal was similar to that for the rock section but somewhat more complicated by reason of the fact that certain changes in the design of the earth section involved changes in the excavation throughout the length of the rock section. The differences in procedure were thus largely a matter of properly taking care of all the variations in cost.

Pressure Tunnel vs. Open Canal

Early in the consideration of a new Canadian Niagara scheme the engineers of the Commission had decided in favor of the general location adopted for the Queenston Chippawa project, but there was considerable doubt as to the relative advantages of the pressure tunnel as against the open canal. Why the latter was adopted is well set forth in the following extracts from Mr. Acres' paper:

Having tentatively solved the intake and regulation problems, it remained to determine whether or not it was feasible to construct a suitable waterway between the Chippawa intake and the power-house location above Queenston. An exhaustive series of surveys and core-drill borings established the fact that it would be entirely feasible to connect these two points by either the open canal or the pressure tunnel type of waterway, and the next problem was to determine which of these two types of waterway would be the more suitable from the combined viewpoint of pure hydraulics, structural difficulties and hazards, and comparative cost.

In the matter of comparative cost, carefully compiled estimates indicated that throughout the full range of assumed carrying capacities the open canal had a decided advantage over the pressure tunnel.

Pressure Tunnel Disadvantages.—In the matter of structural difficulties and hazards the following main points were given consideration in the case of the pressure tunnel:

(a) The necessity of driving the headings at an acute angle through the various limestone, shale and sandstone formations, involving the certainty of a heavy overbreak and expensive timbering and lining.

(b) The unfavorable conditions as regards the disposal of excavated material.

(c) The unknown water hazard and the impossibility of predicting the cost of unwatering within reasonable limits of accuracy.

(d) The difficulty and hazard attending the driving of and maintaining a pressure tunnel of unprecedentedly large diameter in the clay formation of the Whirlpool ravine.

(e) The difficulty in connection with the construction of a distributing chamber in the shale and sandstone at Queenston.

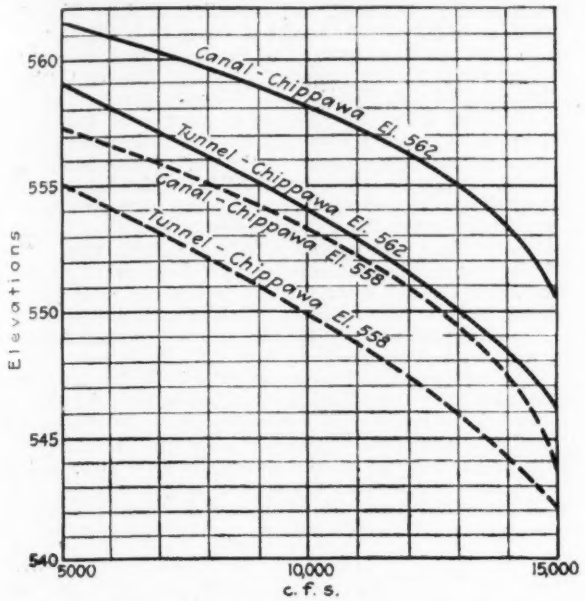


FIG. 6. FOREBAY ELEVATIONS FOR CANAL AND DISTRIBUTION ELEVATIONS FOR TUNNELS FOR VARIOUS DISCHARGES

As against the above, the difficulties and hazards in the case of the open canal were limited to two main points; first, the removal of the earth overburden in the canal prism, and second, the permanent holding of the slopes subsequent to such removal. While it may never be possible to establish finally the comparative importance of the above points on the basis of actual construction, the fact remains that the work already accomplished on the open canal has demonstrated beyond doubt that the overburden can be removed with no more difficulty than was anticipated and that the means originally devised will hold the banks safely within the limits of the predetermined slopes.

Hydraulic Comparison.—In the matter of purely hydraulic comparisons, the first point to consider is that both types of waterway of necessity would have the same point of intake at Chippawa and the same point of discharge at Queenston, so that they are exactly on a par as regards the utilization of available gross head, neither having any primary advantage over the other in this regard.

Since 1902 the water level at Chippawa has been observed and recorded twice daily and Fig. 5 shows the mean daily elevation for the ensuing period compiled in the form of a duration curve. The following facts are deducible from this curve.

(a) The mean level for the entire period is about El. 560.8.

(b) A level of El. 559.5 or higher is obtained for nearly 99 per cent of the entire period.

(c) A level of El. 561 or higher is obtained for a little more than one-third of the above period.

(d) That it is reasonable to assume that the effective operating range of levels lies between El. 559.5 and El. 561.

As to the possibility of the carrying capacity of either type of waterway being seriously affected by a permanent lowering of the natural levels of the Chippawa-Grass Island pool, due to present and future diversions of water therefrom, it is essential to consider two facts: first, that any diversion for power purposes from the pool itself will be largely compensated for by the intercepting effect of the diversion works, and second, that the level of the pool can be controlled independently to compensate for any diversion whatever, whether from the pool itself, from the upper reaches of the river, or from Lake Erie direct.

In Fig. 6 an effort has been made to show in graphic form a comparison of the head losses chargeable to each type of waterway under discussion. In making this comparison, a possible extreme low elevation of 558 has been assumed for head-water, and the open canal losses calculated on this basis for a carrying capacity of 15,000 sec.-ft. On the basis of this loss a tunnel was designed of the requisite diameter for the same capacity of 15,000 sec.-ft.

These curves have been computed for the extreme range of possible operating levels, El. 558 minimum and 561 maximum. The shape of these two pairs of curves illustrates clearly the basic difference between the two types of waterway. Under the assumed conditions the tunnel and canal curves for the head-water elevation 558 and 15,000 discharge drops off, however, it is seen that the canal delivers any fixed discharge to the forebay at a consistently higher elevation than in the case of the tunnel. This is simply due to the inherent characteristics of the two types of waterway. In the case of the pressure tunnel the discharge area is necessarily constant and any gain in head is due to decreased friction only. In the case of the canal the reduction in velocity not only reduces the friction losses, but the retardation of flow increases the effective discharge area of the canal section. By reason of this extra factor the open canal has an advantage over the tunnel ranging as high as 5 ft. of head loss. When the high discharges

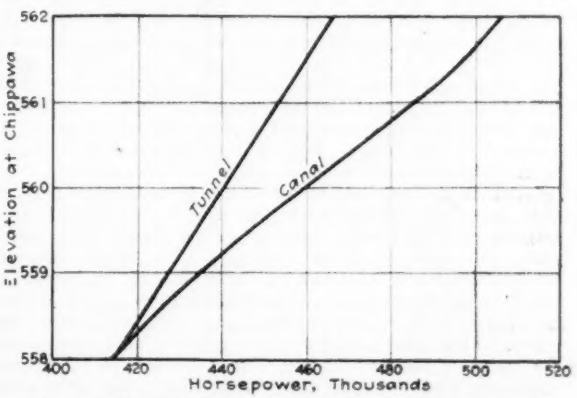


FIG. 7. HORSEPOWER CAPACITY AT CHIPPAWA FOR CANAL AND TUNNEL OF EQUAL LOW-WATER CAPACITY

involved in the problem are considered, it is evident that this difference in head loss is a very important factor.

The curves shown on Fig. 7 have been plotted on a different basis, but with the same factors involved. In Fig. 6 head-water level and carrying capacity have been assumed constant and forebay level the variable. In Fig. 7 head-water and forebay level are the constants and carrying capacity expressed in horsepower is the variable. In this latter curve forebay level is assumed constant at the fixed minimum elevation for peak load capacity and from this common point the comparative carrying capacities of the two types of waterway have been calculated for specified levels of head-water in the Chippawa-Grass Island Pool.

Here again the two curves have a common point of origin at the point of extreme minimum capacity, but from this point on the canal characteristically pulls away as the head-water level rises, until at the maximum operating level of El. 561 the canal has an advantage over the tunnel of 30,000 hp. in carrying capacity. This gain is due to the fact that the tunnel can only realize the gain of a trifling increase in gross head, and a resultant trifling increase in pressure gradient, as the level of head-water rises, whereas the canal gains a material increase in natural gradient and effective discharge section. This increase in carrying capacity is therefore gained by the canal without any reduction of operating head at the forebay, whereas the tunnel can gain the extra capacity only at the expense of a reduced operating head.

The conclusions which may justifiably be drawn from the above discussion are: first, that starting from the common basis of equal loss and carrying capacity at extreme

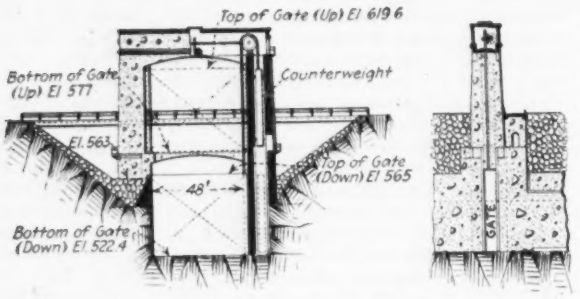


FIG. 8. CANAL CONTROL GATE FOR QUEENSTON-CHIPPAWA POWER CANAL

minimum head-water level, the open canal will deliver the required quantity of water to the forebay with a materially less loss of head than the pressure tunnel, for any head-water level above the assumed absolute minimum; second, that starting from the common basis of a fixed minimum forebay level, the canal will deliver a constantly increasing quantity of power in proportion as the level of head-water rises above the assumed extreme minimum level, which the pressure tunnel cannot do to any appreciable extent by reason of its inherent hydraulic characteristics; and finally, that the open canal is the only agency, under the above conditions, which can make automatically available the large quantities of excess power resulting from any temporary or permanent increase in the level of the Chippawa-Grass Island Pool, above the extreme minimum level which has been used as a basis of comparison.

Another distinct advantage of the open canal is the fact that it can effectively and inexpensively take advantage of any water which might now or in the future be available from the Welland Canal system. This open waterway would furthermore furnish the only means, in connection with the upper reaches of the Welland River, of reclaiming the unused 9-ft. of head in the Niagara River above Chippawa. This would involve a very heavy expenditure, but the value of power will not always be judged by present standards and the time may well come when this extra power may be considered worth reclaiming at a capital cost per horsepower ten times greater than is considered justifiable at the present time. These are more or less remote contingencies, but the fact remains that the choice of the open type of waterway, and the layout of the rest of the scheme will enable effective advantage to be taken of these conditions whenever the public need may become sufficiently acute. When this happens the extreme limit of conservation will have been realized in the matter of utilizing the gross difference in level between Lake Erie and Lake Ontario, and the anticipatory provision made in the present design will have justified itself.

Hydraulic Installation

The hydraulic installation of the new project is of extraordinary interest, not only on account of its record size but also because of specific details. The important features which diverge from practice are the huge single-leaf control gates near the beginning of the canal, the 50,000 hp. turbines which are the largest ever built, the record size Larner-Johnson valves, the location of the power-house floor at the top level of the generators so as to provide space beneath for ventilation and the special details of ice-skimmers and track racks. These points were described as follows by Mr. Sauer:

A single motor-operated vertical lift roller gate for the purpose of controlling or entirely shutting off the flow will be installed at the upper end of the canal near Montrose where the earth section of the canal merges into the rock section. The combination of span and head make this gate the largest ever built and particular attention is being paid to the roller design in order to secure bearing loads well within safe, structural and operating limits. The clear width is 48 ft. and the height of the gate is 42½ ft.

It is of course essential that the canal shall deliver sufficient water to the power plant under the most adverse conditions of water level in the Niagara River. The canal is therefore designed to deliver a quantity of water equal to its rated capacity when the river is at its lowest stage.

The general arrangement of the control gate is shown in Fig. 8. It will be noted that the lift is extended to a point 14 ft. above the water level and this has been done in order to permit a patrol tug to pass freely up and down the canal when the gate is in normal position, i.e., wide open.

The gate will be counterweighted and operated by a motor connected through a worm drive to the two main hoisting gears, and the motor will be provided with distant as well as local control so that the gate can be operated from the power house if required.

The gate itself will be made up with horizontal trusses spanning the opening and vertical beams to which the skin plate will be riveted. It is not important that the gate be absolutely watertight when closed although "stanching" bars will be provided to insert between the skin plate and the end guides which will make it practically tight.

A comparative analysis of costs and operating conditions was made on the single gate as against two gates with an

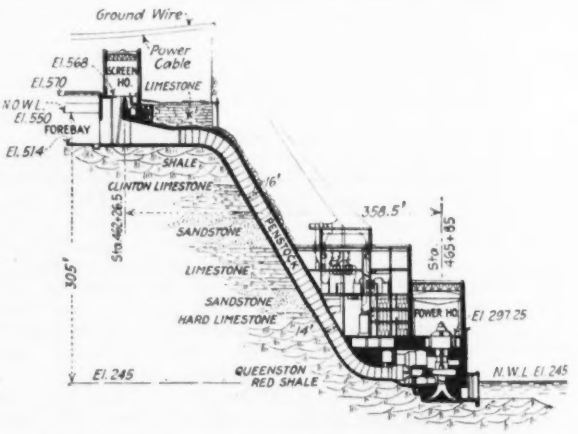


FIG. 9. CROSS-SECTION THROUGH 500,000 HP. POWER HOUSE AT QUEENSTON ON NIAGARA FALLS

intermediate pier, and it was found that the cost of a single gate and superstructure did not exceed the cost of the twin gates, on account of the additional construction required by the intermediate pier and the necessary widening of the canal to keep down the velocity to normal. When the added advantage of having a clear unobstructed waterway was taken into account as well as the simplified operation of a single gate in place of two, the decision was entirely favorable to the single large gate.

It is expected that the intake as designed will take in water from the Niagara River, absolutely free from floating ice, but to take care of any ice that may form on the surface of the canal or the Chippawa River channel a small ice chute is being provided at the lower end of the forebay. It consists simply of an opening through the screen house provided with a drop gate which can be lowered below the water surface for a depth of 12 ft. The discharge over the gate is carried through the screen house and down the cliff under the power house to the lower river in a reinforced concrete pipe 10 ft. in diameter.

An elaborate design of ice skimmer has been made up which if found necessary can be installed later on. This consists, in general, of a reinforced-concrete horizontal pivoted leaf which can be raised or lowered in accordance with the water stage so that floating ice will be skimmed off the surface to a discharge channel, at the same time allowing the clear water to pass underneath. Provision is now being made in the outer wall of the curve in the

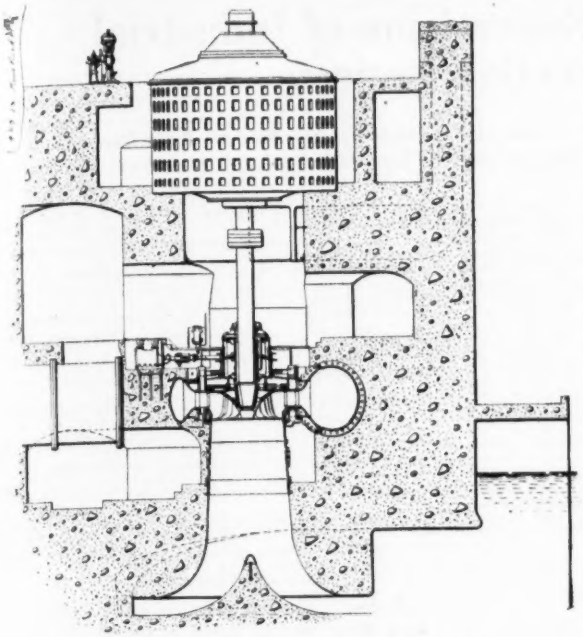


FIG. 10. SECTION THROUGH ONE OF THE 50,000 HP. WHEELS

canal immediately above the forebay so that this skimmer can be installed in the future if it is found that sufficient capacity is not provided in the smaller ice chute through the screen house.

The only features of the screens worthy of comment are the wide bar spacing of 4½ in. in the clear and the layout of the bars and frames which are so designed that the whole frame with the bars attached is removable thus leaving a completely unobstructed passage when they are removed. There are three bays of screens for each penstock and two frames in each bay. The tops of the screens are eight feet below the normal surface of the water and the maximum velocity of water through the screens is 2.25 ft. per sec. With these provisions it is not anticipated that another anchor ice will cause much trouble.

Penstocks

In view of the fact that a Johnson valve is to be installed at the lower end of each penstock adjacent to the turbine it has been decided to omit permanent gates in the screenhouse at the penstock entrance. To take care of any failure in the valves, removable structural gates made up in sections will be provided which can be lowered into any penstock entrance by means of an electric traveling crane in the screenhouse.

The quantity of water used by each turbine at full load and under normal head is approximately 1,800 sec.ft. and in the design of the penstocks, the diameter was fixed by plotting up various curves showing the value of lost power due to varying velocities and their consequent friction losses as against the carrying charges on the corresponding penstocks. By this means a diameter of approximately 15 ft. was found to give the best value, but so great a diameter at the lower end required a plate thickness of over 1⅛ in. and this was considered beyond the limit for safe field riveting. On this account the diameter of the upper two-thirds of the pipes was made 16 ft. and the bottom third 14 ft. which made the construction work feasible and at the same time gave the desired economical results. The total loss through the screens, penstocks and valves is 1.25 ft. using a value of C-110 in the Hazen & Williams formula. The loss is considerably reduced by the use of butt girth joints with an outside cover plate as against the customary practice of using inside and outside courses.

Five turbines are at present under contract, which is one-half the ultimate installation. They are each of 50,000 hp. rated capacity of the vertical, spiral case, single runner Francis type and will operate at a speed of 187½ r.p.m. This gives a specific speed of 36. The maximum guaranteed efficiency is 90 per cent, although in view of recent practice it is expected that this efficiency will be exceeded. On model runners of homologous design tested at Holyoke 91 per cent was obtained. The inlet diameter of the scroll case is 10 ft. and the diameter of the runner is 10 ft. 5 in. at the inlet. Fig. 10 shows the turbine setting and it will be noted that an open space has been left in the power-house foundations below the runner so that by removing a section of the draft tube the runner can be taken out from below, thus obviating the necessity of dismantling the generator when a renewal of the runner is necessitated. The runner is designed for a capacity of 61,000 hp. and is "gated back" to a maximum capacity of 55,000 hp. The reason for this is that the turbines, which will normally operate at or near full rated load, will also therefore operate at their maximum efficiency. Special taps have been provided in the crown plate and from the annular spaces around the discharge side of the runner to which gages can be attached and a record kept of the varying pressures at these several points. This will furnish an indication of the wearing away of the runner seal and show when renewals of seal rings are necessary. Connections from these chambers to the scroll case and draft tube will allow readjustment of the downward thrust when required.

The runners and spiral casings are cast steel and a test pressure of 260 lb. per square inch is required in the latter.

The centrifugal head, relay valves, and hand control for each governor will be located on the generator floor while the main automatic valve control will be located directly under the governor stand at the level of the turbine regulating cylinders. The advantages of this arrangement are the short piping between the main valve and the regulating cylinders and the separation of the two main parts of the governors, giving freer access for repairs and maintenance. The pressure fluid will be water, probably treated with bichromate of potassium, which will prevent rusting of the wearing parts and at the same time give a lubricating value to the water. A central pumping system will be used, with duplicate motor-driven multistage centrifugal pumps, either one of which will have sufficient capacity for all the governors. The pressure fluid will be piped to all the governors through accumulator tanks, one located near each governor so as to eliminate any inertia effects through the piping system. The pump motors are automatically controlled by relay switches which are controlled by pressure variation in the system. As a further safeguard for preserving continuous operation in the event of failure of the pumps or motors penstock pressure can be turned into the governor system. When the plant is finally extended to its full capacity a complete duplicate pumping system, similar to the one above described will be installed and interconnected with the present system.

Control Pedestals

A control pedestal will be set up adjacent to each generator, and on this will be mounted the various indicating instruments, and control room, together with the local control and indication, will be located in such a way that the floor operator can handle the machine while in touch with the chief operator.

A telegraph communication, similar to a ship telegraph and a loud talking telephone, both communicating with the control room will form the principal means of communication. In addition to this a signal lamp mounted at the top of the column over the control pedestal will enable the chief operator to call the floor operator to the unit as required. The air brake and Johnson valve control will also be mounted on this pedestal. The location of this pedestal adjacent to the governor places the control of all the pertinent features of the unit within easy reach of the operator, while at the same time he will be in communication with the control room. The various indicating instruments will at the same time be under his observation.

The Administration and Supervision of Industrial Housing Construction Projects

Condensation of a Chapter from a Book on "Industrial Housing" by Morris Knowles, Consulting Engineer, Pittsburgh, Pa., Just Published by the McGraw-Hill Book Co., New York

IN the development of an industrial housing project the effective organization and wise direction of a competent and experienced personnel is a prime requisite to success, if the result is to be judged on the basis of economy, attractiveness, saleability and good living conditions. To a large extent satifactory results will depend, first, upon the selection of fully competent and experienced services, and second, upon the laying down of carefully considered and co-ordinated organization, planning and construction policies. The expert services of the engineer, the town planner, the architect, the realtor and the construction man are all required. And the several problems falling within the province of each are to be solved, so that the solutions may be not only technically correct, but also economically sound, and so that the way each thing is done may bear the proper relation to the scheme as a whole.

Group Management—The building of a housing project can neither be considered as wholly an architectural nor an engineering problem, but rather as a merging of opinions and talents of each profession into a consistent conception. As there are a multitude of elements which enter into the final plan, the factors of control and co-ordination become most important, and it is therefore necessary to work out a practical form of organization and to formulate the policies of procedure in accordance with which the work shall proceed.

Executive Control—A close contact between the owner and the organization provided to manage and supervise the development is essential. This can best be accomplished by the designation of an official by the owner upon whom the necessary authority is conferred, to fix policies, to make decisions, to execute contracts, to expend funds and to exercise similar important functions. The direction of the work and the immediate control of the housing organization should be centralized in an executive who possesses the necessary qualifications of leadership and who has had the necessary experience in directing the planning and construction of large projects. Special training in directing the design and in technical details will be most helpful, providing the man also has business experience and executive ability.

Method of Procedure—The controlling features, requirements and policies should be laid down at the outset and a program of procedure in preliminary form should then be adopted. The earlier the method of procedure is decided upon, the less likelihood there will be of incurring delays and costly mistakes. The object of working out a well considered plan of procedure is to assume the orderly and economic prosecution of the work at various stages, and to avoid loss of effort, duplication and conflict in authority. Such a plan may be considered as analogous to a routing plan in a manufacturing process; beginning with the making of the designs and working drawings, then passing from department to department and from shop to shop, all in accordance with a carefully prearranged scheme, the finished article finally emerging a completed product, conforming in all respects to the requirements.

Elements of Program—The ordinary procedure, after first having ascertained the general need of housing, is about as follows:

A. Determination of housing requirements, as to the number, general type and allowable cost of houses; the method of disposition, as to whether the house will be rented or sold, or held by a co-partnership company, or by a combination of methods; determination of the approximate amount that can be expended upon the development of the site and in providing street improvements and utilities.

B. Investigation of available sites, suitable for the number and type of houses determined upon as result of the previous study; this involves consideration of the relative advantages and costs of development of alternative sites; requiring comparisons between cost of land, of preparation of the sites, and of building and complete development.

C. Acquisition of site, including examination of title, property survey, preparation of map, and purchase.

D. Topographical surveys and detail map; preliminary study of the town plan and of lot subdivision; studies of types of houses, including development of preliminary sketches, floor plans and elevations and schedules of estimated cost, based upon local data; development of preliminary plans for lot grading, street improvements and utilities, to a sufficient extent to determine the general character and approximate cost; preparation of preliminary budget, based upon the information and data developed in the foregoing studies.

E. Review, criticism and revision of the preliminary plans and estimates, leading up to the adoption and approval of definite general plans; estimates of the cost of the several parts of the work and the preparation of a definite budget of cost.

F. Preparation of detailed construction and working drawings, together with construction specifications; filing and recording plans with proper authorities; arrangements with public utility companies.

G. Award of contracts; including invitation to bidders, receiving and comparison of bids, award, and execution of contracts.

H. Construction program, record of progress, accounting and supervision and inspection of work.

I. Preparation of record plans and drawings.

Necessity for Budget—The preparation of a budget is necessary both as a guide and criterion to follow, in working out the plans and designs for the development, and also as a means of financial control of construction.

Analysis of the budget from time to time will indicate the advisability of increasing the allotments for some and decreasing those for other portions of the work. The necessary degree of flexibility must be provided in the budget, to take care of variations in the labor and materials market and in business conditions. This is provided for by allowing a contingent reserve of from 10 to 15 per cent.

Suggested Budget—The following is a suggested form of budget for general use in the development of an isolated housing project. Certain items, such as the installation of water, gas or electric service, if supplied by and at the cost of a public utility company, would not be included, except to the extent that the builders or owners might pay in annual service charges:

1. *Cost of Land*—Including legal services, recording, property survey and purchase cost.
2. *General Site Improvements*—Clearing, grading, etc.
3. *Houses*—Listed by number and type.
4. *Building Other Than Houses*—Including stores, community and public buildings, schools, churches, etc.
5. *Lot Improvements*—Grading, seeding, sodding and planting; fences, housewalks.
6. *Street Improvements*—Grading; curbs and gutters; pavements; sidewalks; seedings, sodding and planting in planting strips and other open spaces on streets; catch basins and inlets, including connections.
7. *Parks and Playgrounds*—Boulevards and parkways, including grading, construction and adornment.
8. *Water Supply and Distribution*—Supply, including pumping stations, reservoirs, supply mains, filter plants, etc.; distribution system. 8a. *House Services*—House to curb and curb to main, may be separated in jurisdiction and chargeability.
9. *Sewerage and Sewage Disposal*—Collection system; outfalls; sewage disposal plant. 9a. *House Connections*—(Excluding any portion included in house contract.)
10. *Storm Water Drainage System*—Collection system, main drains, etc. 10a. *House Connections*—(Excluding any portion included in house contract.)
11. *Central Heating Plant*—Supply, distribution and house connections.
12. *Refuse Disposal*—Incinerators or other disposal equipment.
13. *Gas Supply and Distribution*—Supply, distribution system and house connections.
14. *Electric Supply and Distribution*—Supply, distribution system and house connections.
15. *Street Lighting*—Supply, circuits, poles, lamps, etc.
16. *General Overhead*—Including professional services, engineering, architectural and town planning; administrative, financial management and general expenses during organization and construction; contractors' profit and all charges which cannot be charged to any of the foregoing items, and for which a separate charge is not set up.

Where the work is done directly by the owner, or under some of the forms of cost plus contracts, it may be desirable to set up separate charges for such items as railroad siding and yards, temporary storage yards, and other general items of construction; otherwise, where not so charged,

these costs are distributed among the various items of the budget.

Construction Policies—An early decision should be reached as to the policy to be followed in carrying on construction, in order that the plans and specifications may be drawn in conformity therewith. In making this decision, a choice must first be made between having the owner do the work directly, or by force account, utilizing his own construction organization, purchasing materials, hiring labor and buying or renting plant; and having the work done by an independent organization under some form of construction contract.

Force Account—Construction by force account may be carried on where the owner maintains a permanent construction department with competent personnel, or where an engineering organization, which has demonstrated its capacity for handling work in this manner, is employed. In such cases the owner assumes all of the risks and performs all of the functions which would be divided between himself and a contractor on a contract job. His organization will therefore have to be practically as large as the combined organizations of owner and contractor, and under ordinary circumstances no advantage can be obtained by handling the work in this manner, sufficient to offset the superior organization, experience and plant of a reliable and experienced contractor.

On force account work, no contract need be drawn and general specifications need not be so formal, but if satisfactory work is to be assumed the plans and technical specifications should be fully as complete as on contract work, in order to guide and instruct those in immediate charge of the various portions of the job. In other respects, the discussion of construction problems below will apply to force account work, with due allowance for the identity of owner and contractor.

Contract—If the work is to be done by contract, various forms of contract are to be considered, each having particular advantages. The essential differences between them are in the method of payment and in the degree of risk and financial responsibility assumed by the contractor.

Assuming that the contractor is fully competent, and experienced and that he has adequate plant, capital and organization, and is in every respect dependable and reliable, there is, under present-day conditions, a general feeling that the cost-plus form of contract, or some of its modifications, will give better results and be more equitable to both parties than the lump sum or unit price contract. In this form of contract, the owner pays the actual cost of the work, plus a reasonable profit to the contractor for his services.

The cost-plus form of contract is more difficult to administer and supervise than others, and the success of the undertaking will, to a certain extent, be dependent upon the degree of confidence existing between the parties. While the contract, in general, provides that any losses or costs, due to the negligence, incompetence or carelessness of the contractor, shall be charged to and be borne by him, it is difficult to clearly establish responsibility when controversies arise, and it is therefore extremely important that discretion and judgment be exercised in selecting the contractor.

Supervision of Construction—The extent of the organization to supervise construction will depend upon the extent of the work and the form of contract under which it is to be executed. In any event, the force must be organized to give general supervision, to inspect the materials and workmanship, to give the necessary lines and grades for the construction, to keep records of progress and for certification of payments. Where the work is done on a cost-plus basis, there must further be provision for financial control, for time-keeping and checking of labor, materials and bills, and, if the materials are to be purchased by the owner, a purchasing department must be included.

It will be necessary that the owner have sufficient control over the work to insure that the contract is carried out in accordance with its terms and that his interests are fully protected. To this end it is necessary and advisable to supervise the construction with the same degree of care as that followed in the preparation of the plans and designs. A construction superintendent or manager should be placed in immediate charge of the work, and should report directly to the executive officer in general charge.

Construction Program—A program of the order in which construction is to be carried out should be devised at the inception of the work. This will provide for the work and sequence of the various operations, enable materials to be ordered and distributed without delay and confusion, and prevent the interference of one part of the work with other parts.

If construction economy and demand for early completion of the houses were left out of consideration, the most desirable plan would be to first execute the general grading of the site and complete the street improvments and utilities and thereafter build the houses, but it is ordinarily not feasible to follow this plan, as it will generaly require two working seasons. It will therefore usually be necessary to make reasonable provision for temporary construction roads and to proceed with the construction of houses, after the rough grading has been done, in one part of the tract, while street improvements and utilities are carried along in another part. By suitably dividing the work up into several sections, a continuous use of various sized gangs of labor and skilled workmen may be worked out, which will not only produce more satisfactory labor conditions, but will expedite and reduce the cost of the work.

Yards and Delivery of Materials—The expense of handling materials, in unloading, hauling, storing and delivering is a very appreciable item in the cost of construction. When the size of the work warrants, it will be advisable to extend a siding to and into the tract, provided the cost is not excessive compared with that of unloading and trucking from an existing siding. This siding should be extended in such manner as to enable a storage and unloading yard to be developed in a location which will be convenient for the delivery of material by trucks to the various parts of the tract.

Sanitation—Unless the project is a small one, and particularly when the site is remote from built up districts, the construction of contractors' camps will be required. The sanitation of the contractor's camp surroundings and food supply cannot be neglected without running a grave risk of having infectious diseases break out and spread. This will not only delay the work but may create a prejudice which will react against the success of the project.

Temporary Fire Protection—Fire protection becomes a very important feature in the construction of a large number of houses in isolated districts beyond the service of established fire departments. It will frequently be necessary in such cases to provide temporary means of fire protection until the installation of the water-supply distribution system has been completed and permanent fire fighting equipment has been provided and its personnel organized. Such temporary fire protection measures will include the designation of one of the construction men as fire chief, with a sufficient force of men readily available from the construction forces. Fire signals for giving the alarm must be provided and occasional drills held in order to familiarize the men with the facilities and equipment and methods to be followed. The equipment should consist of an ample number of barrels of water, with buckets suitably marked at each building, and a supply of chemical fire extinguishers located at specified points. An important provision in the fire regulations should pertain to the location and isolation of buildings containing inflammable or combustible materials.

Temporary Water Supply—The permanent water-supply distribution system should be planned and constructed, so as to minimize as much as possible the extent and cost of temporary water supplies for construction and fire protection purposes. Pending the installation of the permanent lines, it will be necessary to lay temporary water lines, which will usually consist of 2-in. screw joint pipe, laid directly on the surface of the ground with suitable covering at road crossings. Proper consideration must be given to the source of supply, and provision made for the constant

supervision and protection of its sanitary quality, if necessary, by the use of disinfection or filtration.

Construction Roads—The extent to which construction roads must be built will depend upon the size of the project and the character of the soil. Where possible, temporary construction roads should not be built until the streets have been rough-graded, and consideration should be given to whether economies may not be realized by utilizing the graded permanent streets and alleys for the location of construction roads.

The extensive use of modern heavy trucks has made the requirements of temporary construction roads more severe than was the case a few years ago; the trucks are operated at a much higher cost per hour than in the case of horse-drawn wagons. It is therefore possible and necessary to provide a road surface of sufficient wearing and bearing qualities to permit the efficient operation of such heavy vehicles. Cinders, local gravel or broken stone can be used for surfacing; heavy planks or corduroy are frequently suitable for such temporary roads.

Progress and Cost Reports—An important function of the construction organization is to compile information for and prepare reports as to the progress and cost of the work. A progress chart, covering the details as to the time of starting and completion of each part of the work, is of great value in the management of construction. Unavoidable delays and conditions will undoubtedly cause modifications in the original program and its enforcement can be accomplished only by periodic reports as to the progress actually made on each part of the work. In this way, delays affecting any part of the work, with the possibilities of interference and confusion, will be detected, and steps may be taken for the rectification of conditions.

Cost accounting and cost reports will constitute one of the most difficult items of administration of construction. The cost accounting will require the formulation of a simple but effective method of obtaining the cost of labor and materials and their distribution among the various items of work. The accounting work should be placed in direct charge of an official whose experience and qualifications include both those of construction accounting and the practical direction of construction work. The ordinary accounting methods are entirely unsuitable for the purpose in hand. Where the work is being done under a cost-plus form of contract, it is absolutely necessary that those in executive charge of the work have at hand at all times the actual cost of each part of the work, for the reason that there is no other method of determining whether or not the work is being carried out at a reasonable cost. In this manner, instances of leakage, waste, incompetence or improper methods of construction may be detected and corrected.

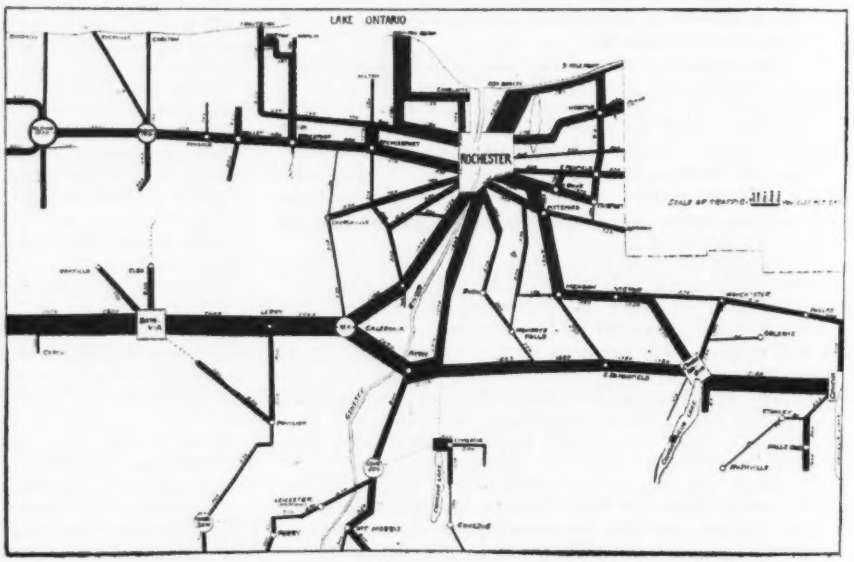
Record Plans and Reports—Record plans should be prepared of the development as acutally constructed. These will include the plans relating to final street locations, property lines and easements which will be necessary, for recording and describing properties and easements, and in dedicating or deeding streets or highways to the municipality. These record maps should show, in plan and profile, the definite location of the street lines, and the location of monuments and necessary information and should further show definitely established grade lines. A record map should further be prepared showing the property subdivision, block and lot records and house locations. Record plans of the street improvements, utility systems and house services and connections should be prepared which will show location, character and size, in sufficient detail so that the necessary information will be available when required.

Line Widths in Photographic Chart Are Measure of Traffic Density

By Charles M. Edwards
Division Engineer, New York State Highway Commission

THE accompanying photograph is a reproduction of a chart showing graphically the traffic conditions in Division 7 of the New York State Highway Commission. The figures are based on traffic censuses taken by employees of the commission on a Saturday and Sunday in August, between the hours of 7 a.m. and 7 p.m., the results being tabulated as daily traffic.

Censuses included vehicles of every kind. The dotted lines show connecting, unimproved roads, which the traffic uses to get to the state highways. This chart will be useful in determining the types that should be used for future resurfacing and reconstruction, and also, as the state highways are extended, the changes in the amount and direction of traffic from year to year. No figures were taken in cities as the state maintains no highways within them. The main thoroughfare from Rochester to Charlotte being within the city limits will account for an apparent discrepancy in that section.



TRAFFIC DENSITIES GRAPHICALLY SHOWN BY PHOTOGRAPH

It may also be noted that a peculiar condition exists in the southeast section, where a large amount of traffic is diverted over a town improved highway, which is not shown, as the figures were taken only on highways maintained by the state. The same is also true of the conditions at the north end of Conesus Lake, where a large summer colony of Rochester and Geneseo people use the unimproved road on the west side of the lake.

Wire Cage Saves Wages of Watchman

To save the expense of a watchman for a pipe trenching machine at Springfield, Mass., the water department had a wire cage made to enclose the machine when out of use on the street. The cage cost about $400.

Report on Water-Supply Needs of Philadelphia

Consulting Engineers Advise Ultimate Abandonment of Present River Sources Preceded by Improvements and Metering

THE ultimate abandonment of the Schuylkill and Delaware rivers as sources of water supply for Philadelphia, except that the Delaware above Trenton would eventually be drawn upon as a supplementary supply, has been recommended by a Board of Consulting Engineers appointed by the mayor in July to report on extensions and improvements the water-works needed immediately, together with a plan to meet the needs of the city for the next fifty years. Taking into account the general financial condition of the city and its need for other improvements, the board recommends that the construction program for the next five or six years be limited to an outlay of $35,000,000, of which $27,000,000 would be spent for improvements and extensions to the existing works, including the distribution system, and $8,000,000 for the first steps toward the abandonment of the present sources of supply.

The new sources of supply recommended are storage reservoirs on Perkiomen, Tohickon, and Neshaminy creeks, the first two being tributaries of the Schuylkill River and the third a tributary of the Delaware River, but only the Perkiomen would be developed in the near future, while at the same time facilities for supplying water from the Schuylkill and Delaware pumping and filtration plants would be increased. The new sources would provide "semi-gravity" supplies. The program calls for the extension of the meter system "as rapidly as possible." The Board of Consulting Engineers consists of the following: J. W. Ledoux, Philadelphia, chairman; George W. Fuller, New York City; Joseph F. Hasskarl, Philadelphia; J. Waldo Smith, New York City. The report is dated Sept. 15. In general, it agrees with the opinions of C. E. Davis, chief of the Water Bureau of Philadelphia, as stated in a letter of information submitted by him to Mayor Moore on July 9, for the information of the board.

Defects in Existing System—Quality of Water

Before detailing its ideas on changes in the present water-works system the board outlined "some of the more important defects" in the existing system. The "city is seriously menaced," the report states, "by many weak points in the existing water-works where ordinary slight accidents" cause low pressures in important sections of the city, thus increasing the ordinary fire hazard. Reserve equipment is insufficient. The water-supply facilities are too largely concentrated "in a single chain" without relief connections. At the Torresdale pumping station (the pumping plant on the Delaware, supplying the Torresdale filters) there is a single inlet pipe to the station and a single outlet to the preliminary filters. There should be a new low-lift pumping plant here, with its own intake and outlet connections. At other stations the pumping capacity and intake or discharge connections are inadequate. The present "defective and leaky dam at Fairmount," on the Schuylkill, "should be replaced by a modern masonry structure as early as possible." Unless this is done, "ice gorges or floods may injure the present structure and render two pumping stations useless."

On the quality of the present water supply the report says:

The unfiltered water as drawn from the Delaware and Schuylkill rivers is now, and for many years has been, seriously polluted. The substantial pollution throws a serious burden upon the filter plants and this has been recognized by installing arrangements for preparing the water for filtration, such as sedimentation in large basins, preliminary filtration, or both; also by the use of sterilizing methods applied to the water after filtration and before its delivery to the consumers.

In general water purification practice the custom has recently been established of investigating filtration projects by ascertaining the load factor under which the filters operate and the quality of the finished supply as measured by the standards prescribed by the U. S. Public Health Service for waters to be used by the carriers in interstate traffic. The International Joint Commission having jurisdiction over the pollution of boundary waters between this country and Canada, has proposed as a limiting load factor on filters an average annual content per 100 c.c. of applied water of 500 B. Coli (intestinal group of bacteria). The U. S. Public Health Service limits the B. Coli content in drinking waters to 2 per 100 c.c. Each of these standards is thought by some to be needlessly rigid but no steps have been taken actively to modify them.

TABLE I. AVERAGE ANNUAL CONTENT PER 100 CUBIC CENTIMETERS OF B. COLI (INTESTINAL BACTERIA GROUP)

	River Water		Applied to Final Filters	Final Effluent from Filters				
Year	Schuylkill	Delaware	Torresdale	Torresdale	Queen Lane	Belmont	Roxborough Lower	Roxborough Upper
1920*	980	730	300	1.1	5.0	4.6	4.6	4.7
1919	940	590	370	0.6	3.4	2.4	2.6	2.5
1918	880	670	340	0.7	1.8	2.6	2.0	1.4
1917	670	810	190	1.1	0.5	0.4	0.1	0.1
1916	730	810	390	0.7	0.4	0.2	0.1	0.2
1915	710	940	...	0.5	0.6	0.1	0.5	0.2
1914	510	750	...	0.8	1.1	0.3	0.5	0.1

* Average January to August, inclusive.

Table 1 shows a summary of the B. Coli content of the local river waters as applied to the final filters at Torresdale, and of the effluent leaving each of the filter plants, arranged as annual averages for the past few years. It appears that the load factor of the river water obtained both from the Delaware and the Schuylkill exceeds the proposed International Joint standard, but the preliminary treatment brings the water as applied to the final filters within the proposed standard.

The records show that the water sent to the consumers up to 1919 readily met the requirements of the U. S. Public Health Service. As happened with several other large water-works plants, the filters during the war reached a condition where they seriously felt the excessive strain under which they were operating and with a consequent falling off in the quality of water as shown by analyses. The State Department of Health is the body which certifies to the railroads and steamship companies, whether or not local water supplies may be served to interstate passengers. It is understood that the test applies to the quality of the water as it reaches the consumer and not as it leaves the filtration plants. The State Department of Health is now considering whether or not it will make such certification for Philadelphia water.

The filter plants are unable to carry their loads as satisfactorily as was the case before the war and they are urgently in need of revamping and enlargement as will be stated below. Notwithstanding the excellent recent record of the city with respect to its low typhoid fever death rate (see Table 2) we consider the present situation as to water treatment facilities a potential menace to the health of the community.

In appearance the city water supply of Philadelphia leaves nothing to be desired. This clear, sparkling water, however, has objectionable tastes and odors at times, par-

TABLE II. DEATH RATE FROM TYPHOID FEVER IN PHILADELPHIA PER 100,000 POPULATION

1920*	3.0	1915	6.5
1919	4.5	1914	7.5
1918	4.8	1913	15.6
1917	6.3	1912	12.6
1916	7.4	1911	14.1

*Up to September 1st.

ticularly in the case of the Schuylkill supply. These tastes are due in part to organic matter coming from polluting matters entering the stream above the intakes, but more particularly to the wastes from industrial plants, such as gas works and plants dealing with coal tar products. The control of these wastes is now being closely watched by the State and City authorities and it is believed that results will be more satisfactory in the future than in the past, although it is not reasonable to expect that the plant operators in the upper valley can at all times prevent accidental "spills" at the appliances used by them for retaining these valuable waste products which are so objectionable to the water consumers.

Relative Hardness

The total hardness of the Delaware River water averages about 50 p.p.m. which is moderately soft as compared with the water supplies furnished to other large cities along the Atlantic seaboard.

The Schuylkill River water flows over a limestone formation for some distance and has about double the hardness found in the Delaware River water. This greater hardness is not a desirable feature of the Schuylkill water, although it is a far softer water than supplied to the vast majority of the cities and towns found between the Allegheny and Rocky Mountains. It is somewhat softer than the water of the Great Lakes which averages about 120 p.p.m. and is approximately the limit below which municipal water softening plants do not strive to reduce the hardness, as at Columbus, Ohio and Grand Rapids, Michigan.

Defects at the several filter plants and their associated facilities for treating the water may be summarized as follows:

Torresdale Works—The present preliminary filters need overhauling and a renewal of the wash water and air distribution system for cleaning the sand beds. The capacity of the plant as a whole should be increased at once by building new filters of a capacity of 50,000,000 gal. daily which should later be increased to 100,000,000 gallons. These filters had best be of the rapid sand type in conformity with the recommendations made for the improvement now being installed at the Queen Lane filter plant. The coagulating basin should have a capacity of at least 10,000,000 gallons.

Queen Lane Filters—These filtration plants are now being revamped to have a capacity on an average of 140,000,000 gal. daily capable of carrying an overload of 20 to 25 per cent.

Belmont Filters—This plant requires baffles and improved inlet and outlet connections to increase the sedimentation period in the existing settling reservoirs. A new $36,000,000 rapid sand filter plant, with an independent coagulating basin, should be installed.

Roxborough Filters—Sedimentation facilities in existing reservoirs should be improved at once and later it will be necessary to install more filter units, depending upon a rearranged program for delivering water at a different pressure in the northwestern part of the city.

As bearing upon the introduction of water from new sources, the report states that whereas the entire Schuylkill supply is pumped before filtration to sufficient elevation for distribution by gravity the Torresdale filters are but slightly above the Delaware.

On the subject of metering the report says:

Meters furnish the most efficient and certain means of controlling waste and of equitably distributing the water rates. Their introduction has always been accompanied by a large reduction in the consumption, and a decided betterment in the service as to pressure and efficiency. The meter principle is growing rapidly. There are now many large cities 100 per cent metered, resulting in the deferment from five to ten years of costly improvements and extensions, and better utilization of those in existence. The advantages of complete metering are so obvious that no opposition should develop. We strongly recommend that the meter system be systematically extended to all services in the city.

Dealing with the ultimate abandonment of the present sources of supply and the inadvisability of going to the Upper Lehigh or the Susquehanna rivers, the report says:

Approved plans are now being executed that will result in increasing the draft from the Schuylkill by 25 per cent. a quantity materially in excess of the observed low flow of this river. This deficiency must be made up by storing water on one of its branches and compensating the stream flow when required. While we recommend that the Schuylkill River be abandoned as a source of water supply at the earliest possible date—largely for sentimental reasons, as with treatment it can now supply a hygienically safe water—we realize that the city's rapid growth requires many improvements other than water and that present prices make construction work very expensive, probably from two to two-and-a-half times greater than in 1914. Our recommendations, therefore, are along the line of the least capital investment consistent with needed improvements and the greatest possible utilization of present facilities.

In our judgment one storage reservoir must be constructed at once in the Perkiomen watershed to which source the city must turn if economy and early improvement in the quality of water supplied are to control. This reservoir will automatically become a part of the extended system after the abandonment of the Schuylkill River within the city limits. It will eventually, with other reservoirs, in the same and adjacent watersheds, furnish water through aqueducts leading direct to the city. Such aqueducts may be designed to deliver water at a sufficient elevation to materially reduce the pumping factor; or the available head may be applied to decrease the size and therefore first cost of the aqueducts, continuing the existing pumping lift from the river levels to the filtration plants, as may be shown expedient at the time of construction. For the present the first reservoir will give a much needed addition to the dry weather flow of the Schuylkill and improve the raw water supply.

Abandonment of Delaware Supply at Torresdale

The Delaware River water at Torresdale is at present better than the Schuylkill water, either raw or filtered. There are periods, however, when the ebb and flow of the tide tends to bring dangerous polluting matter to the intake. The establishment of inland waterways, combined with the natural growth of commerce and industry will, in all probability, result in a large growth of population along the Delaware River shores, and require ultimately the removal of the intake to a more advantageous and safe location. This can easily be accomplished without abandoning the major part of the present investment by taking the water from a point above Trenton. The water could be delivered, after sedimentation in an intermediate reservoir, to the present filters at Torresdale, as then extended and modified.

It would be a far better plan to develop progressively the Neshaminy watershed by constructing storage reservoirs which may or may not be combined with a similar development of the Tohickon watershed, as may then be shown to be the most expedient. Any deficiency in the requirements can be made up by pumping water from the Delaware River above Trenton to one of the storage reservoirs. Thus augmented, and with the Perkiomen watershed fully developed and utilized, there can be made available a supply estimated at over 700,000,000 gal. daily—sufficient to supply the city for an indefinite period.

For more than fifty years the watersheds in the counties adjacent to Philadelphia have been pointed out as the ulti-

mate external source of supply. Without elaborate investigations or long consideration, it is obvious that the city cannot overlook these nearby sources and go further afield when, by reason of growth or dangerous pollution, it must extend its water-works system beyond the present local sources.

Expense grows with distance, and the watersheds of the Perkiomen, Tohickon and Neshaminy furnish a natural and ideal substitute for the present works for many reasons among which may be mentioned:

1. A utilization to the fullest extent of the city's investment in its present pumping stations, filters, reservoirs, and distribution system.
2. The capability of development by successive increments from time to time rather than a nearly complete investment at one time, as would be the case with all the more distant sources of supply.
3. Freedom from any legal interstate complications.
4. The fact that combined with, and augmented by, water from the Delaware River above Trenton, it will furnish an ample supply to the city for much more than fifty years to come.
5. The adoption of this project will insure to Philadelphia a thoroughly pure, wholesome and satisfactory supply, comparing favorably with that furnished to any large city in the country.

We respectfully urge that our recommendation of this project be approved and that the city promptly begin its execution.

Mountain Sources

Water from the distant mountains always appeals to the sentiment of the general public who think of it as crystal-clear, as they have seen it in the bubbling hillside brooks on their excursions afield—cool, refreshing and satisfying. This is seldom, if ever, so, and in the present case it is a highly idealized sentiment and far from the facts, although the mountain sources have many points of excellence, and they are admittedly superior to the supply recommended when both are considered in an untreated condition.

The Upper Lehigh and its branches and the Delaware River tributaries above the Water Gap could furnish a very soft, generally clear, and hygienically safe water which would, however, at times be turbid, have a high color or vegetable stain, and would be subject to occasional dangerous pollution. To make it as satisfactory as the water which Philadelphia is now using would require treatment to remove the color, turbidity and disease germs. *We go so far as to express the opinion that with rare exceptions no surface water should be consumed without filtration or other treatment.* [Italics ours.—Editor.]

The cost of a water supply of a given quantity is roughly proportionate to the distance between source and point of use, other things being equal. Therefore, for economical and business reasons, a city should seek successively, as it outgrows its supply, the available source nearest at hand and reduce to a minimum the abandonment of its existing useful plant. Cities rarely discard on a wholesale basis their existing water-supply facilities, but from time to time reach out and make additions to their supplies.

Works for a supply from a mountain source would require as part of the initial construction, a full size aqueduct capable of delivering the ultimate desired capacity of 500,000,000 gal. per day. Water from a mountain source could be delivered at an elevation sufficient to make pumping unnecessary except for the highest parts of the city. Its introduction would involve, however, radical readjustment, and perhaps entire replacement, of the filtration plants, and extensive changes in the distribution system.

Instead of progressive development being possible, as is the case with the supply herein recommended, all the mountain sources that can be considered as physically available would require enormous initial outlay, with the accompanying large interest charges throughout the period when only a portion of the capacity of the works could be utilized. We believe that all mountain sources should be dismissed from active present consideration, and not taken up until the city's growth approaches the limit of the nearby sources, at which time they may offer the best and most feasible addition.

In view of the conditions stated, detailed investigations of distant sources seemed unnecessary at this time. We have, however, made careful examination of information in previous reports on the water supply, and particularly the very comprehensive data compiled by the Chief of the Bureau of Water, and have prepared comparative estimates of cost several proposed projects.

The main data on which the board bases its recommendations for a future daily supply of 500,000,000 gal., with ability to supply 600,000,000 gal. daily for limited periods, are: With a present population of about 1,825,000 the average daily consumption in 1919 was 311,000,000 gal., or an average of 170 gal. per capital, which was exceeded by 23, 20 and 12 per cent, respectively, during the maximum day, week and month in the past two years. The estimated population fifty years hence is 3,250,000. With all services metered by that time it is assumed that the average daily per capita consumption would be about 150 gal., and the daily total about 500,000,000 gal. The estimated cost per million gallons daily of the recommended semi-gravity project (storage on the Perkiomen, Tohickon and Neshaminy, supplemented by pumping from the Delaware above Trenton) is $270,000, compared with $511,000 for the Susquehanna and $649,000 for the Upper Lehigh possibilities.

The program recommended by the board to cover the next five or six years involves a total outlay of $35,000,000, as already stated, divided as follows:

First impounding reservior on Perkiomen Creek with necessary development of program for stored water supply	$8,000,000
Improvements in and extensions to the Delaware River supply works	$6,000,000
Improvements in and extensions to the Schuylkill River supply works	$4,000,000
Extension of distribution mains and distributing reservoir for the northeast portion of the city	$8,000,000
Extensions and betterments to existing distribution reservoirs and main pipe lines	$5,000,000
General improvements essential for safe maintenance of the plant	$4,000,000

Intercrystalline Fractures and Season Cracking of Soft Steel

Examination of a number of serious cases of service fracture of soft steel at the National Physical Laboratory of England has showed, according to W. Rosenhain and D. Hanson in a paper read before the Iron and Steel Institute, Sept. 21, 1920 ("Intercrystalline Fracture in Mild Steel") that, while the fracture is generally through the ferrite crystals, in a small number of cases the fracture goes between the crystals. All such cases were detail fractures, and most of them occurred in steam boilers. Some evidence was found to indicate that corrosion is a factor in bringing about such fracture, just as it does in the notorious season cracking of cold-worked bronzes and brasses. One of the four cases reported occurred in cold-drawn steel tubing, and in this case the product of corrosive action in the crack could be seen under the microscope. While the authors of the paper suggest that initial stress is a factor in the cracking, as it is in season cracking of brass, they do not find a satisfactory source of such initial stress in boiler shells except in the operation of riveting under excessive pressure. However, heat appears to be a factor in the cracking, for the authors say that they have not yet observed an intercrystalline fracture in soft steel exposed to stress at ordinary temperature only.

Rapid Transit Plan for New York Proposes 830 Miles of New Track

Report by D. L. Turner, Chief Engineer, Outlines Comprehensive Development for Next 25 Years at Cost of $350,000,000—Twenty-One Subaqueous Tunnels and Three Moving Platforms Recommended

TWENTY-ONE two-track subaqueous tunnels, 830 single-track miles of new line, three crosstown moving platforms and two-story subways of eight and of six tracks are outstanding features of the $350,000,000 comprehensive plan for rapid transit development in New York City during the next 25 years proposed in a report which Daniel L. Turner, chief engineer of the Transit Construction Commission, submitted recently to Commissioner John H. Delaney. Emphasizing the point that it has averaged 10 years from the inception of previous general transit projects to the date of their operation, Mr. Turner recommends that the new building program be started at once in order that all of the facilities proposed may be available by the year 1945. Twenty-five years hence it is estimated that five billion passengers per year must be accommodated.

The accompanying map indicates the extent of the project covered by the report, new routes being indicated by dotted lines while existing facilities are shown by solid lines. In addition to extensions to many routes of the present system the comprehensive plan contemplates for the near future two new trunk lines for the east and west sides of Manhattan, including an Amsterdam Ave.-Eighth Ave. route and a Madison Ave. route. The moving platform lines are designed to provide transfer facilities across town between all north and south trunk lines and their locations are through 14th St., 42d St., and 57th St., extending in each case from the Hudson River to the East River.

If the recommendations of the report are carried out the Borough of Richmond, located on Staten Island in New York Harbor, would for the first time, be provided with rapid transit facilities, connections to the Brooklyn lines being supplied by tunnels under The Narrows.

The construction of the new rapid transit lines, Mr. Turner points out, should precede the population and form the basis of the city plan. Upon these two cardinal principles, he believes, the future of the city depends. Extracts from the report follow:

Traffic Growth Enormous

In the past the traffic on the street railway lines in New York City has nearly doubled every ten years. In 1913, the year the Dual Contracts were signed, the rapid transit lines in Manhattan and Brooklyn (subway and elevated lines together) carried 810,000,000 passengers. In 1920 the rapid transit lines, including the old and new lines, will carry about 1,333,000,000 passengers for the year. This means that the rapid transit traffic per year has already increased 523,000,000 passengers, although the Dual System is not yet completely in operation. The present year's rapid transit traffic—1,333,000,000 passengers—is nearly one-half of the total traffic capacity of the Dual System. The Interborough trunk lines in Manhattan are saturated now in the rush hours one way. In about another ten years the whole Dual System will have become saturated with traffic.

The first Interborough subway, just before service on the two new east and west side lines was inaugurated, carried a maximum of 418,000,000 passengers per year. The old and new Interborough subways, although the new lines will have been in operation only about two years, will carry this year about 577,000,000 passengers—an increase of 38 per cent in about two years.

The New York Municipal Railway lines in 1918, at about the same time the east and west side Interborough service was begun, carried about 258,000,000 rapid transit passengers per year. This year they will approximate 378,000,000 passengers—an increase of about 46 per cent in two years.

In 1910 it was estimated that the total traffic on all lines for 1920 (surface, subway and elevated lines) would amount to about 2,600,000,000 passengers. For the year ending June 30, 1920, the traffic amounted to about 2,400,000,000 passengers—practically substantiating the estimate of ten years ago. The total traffic to be provided for in 1945, 25 years hence, is estimated to amount to somewhere around 5,000,000,000 passengers. The population of New York then will be somewhere around 9,500,000 people.

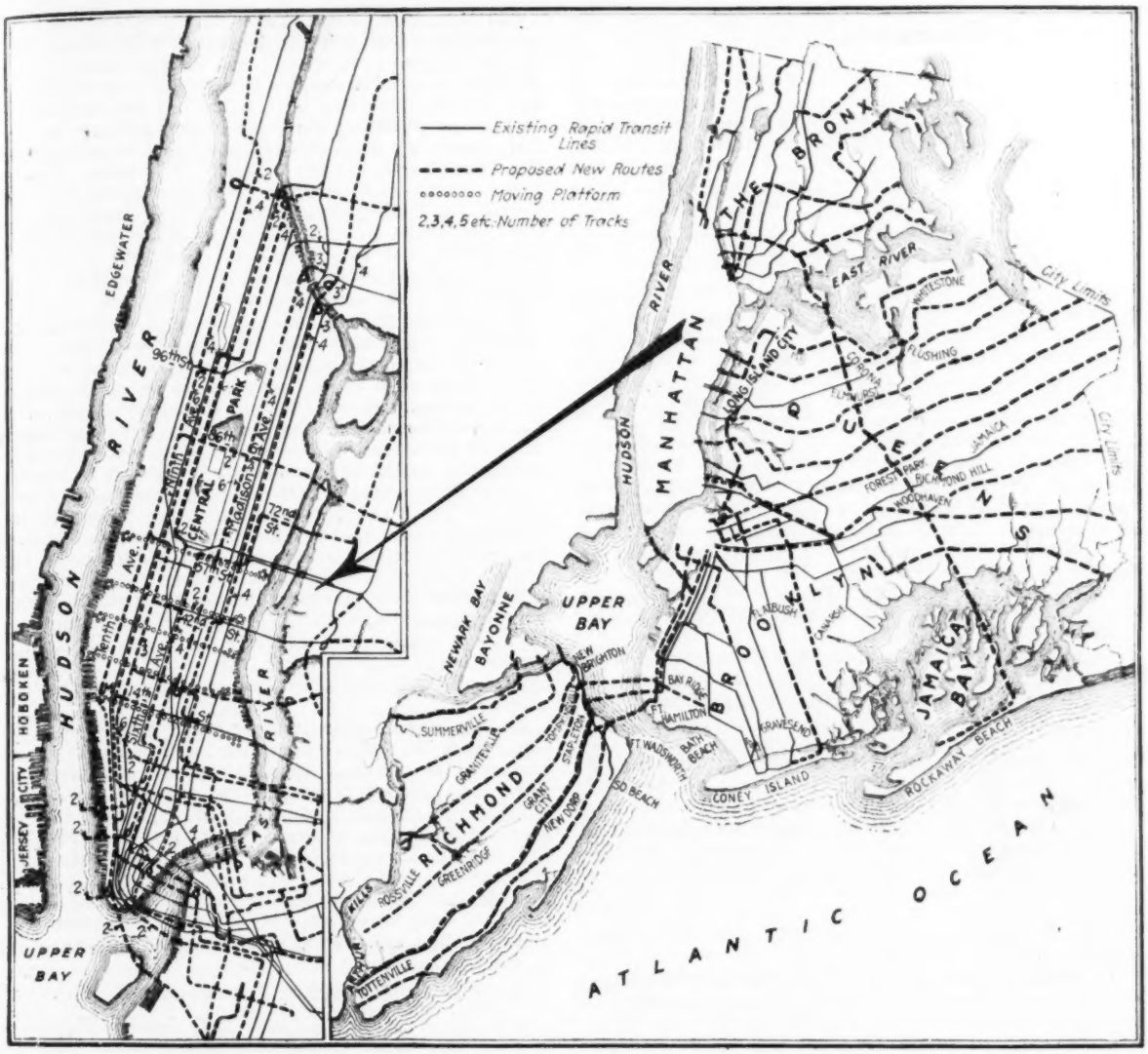
New Lines Should Precede Population

The foregoing figures are sufficient to indicate the enormity of the traffic growth for which municipal transportation must be provided if the development and the prosperity of the city are not to be held back. In order to keep pace with the enormous traffic growth the city must build more transit facilities—then more again—and still more again—and must keep on doing this continually.

The Dual System was planned primarily to best serve the whole community. New lines were laid down through the congested areas. But instead of confining all the new lines to old lines of travel, or to the already congested sections, lines also were laid down in wholly undeveloped portions of the city. It was expected that this principle in planning rapid transit lines, in conjunction with the new zoning law limiting the height of buildings in congested sections, would work together so as to distribute the population rather than to further concentrate it. In other words, as far as practicable, the idea followed in planning the system was that the transit facilities should precede the population—not follow the population.

Convenient Service Basis of Transit Plan

When a city has developed to a point where its outer limits exceed 4 or 5 miles from the center, the congestion in traffic which has developed and the time which is consumed in traveling become such factors that travel on the surface is no longer sufficient, and faster means of transit must be provided between home and business—or between the outlying sections and the center. At this time rapid transit lines must be developed. The first rapid transit lines may be two-track lines—similar to the Manhattan and Brooklyn elevated lines, for example. On such lines, including all stops, passengers can travel at about 15 or 16 miles per hour, so that a 10 or 12-mile radius city can be served properly. As the outer limits of the city become more and more distant from the center, the transit speed must be increased. In response to this requirement the express-local transit service has been developed, similar to the subway lines in Manhattan and Brooklyn. On these express-local lines passengers can travel through the outlying sections on the local trains, making all stops, at the rate of about 16 miles per hour, and through the center on express trains at about 25 miles per hour. The average speed from the outer limits to the center increases with the increase in the length of the express tracks. A line with express tracks running to the end of it could properly serve an 18-mile radius city. In New York, with an existing proportion of express tracks on the subway lines



NEW ROUTES PROPOSED IN COMPREHENSIVE RAPID TRANSIT PLAN FOR NEW YORK CITY

the average speed from the circumference to the center of the city is about 18 miles per hour, thereby, on the hour standard, furnishing satisfactory service 12 miles out. The combination express-local service will thus bring passengers into the center fast enough to permit them to complete their trip between home and work within the desired hour.

Surface transit must be replaced by elevated, open-cut or subway transit. In other words, surface line service must give way to rapid transit service. This evolution in city transit in New York—particularly in Manhattan—is necessary not only because of the tremendous traffic increases which must be accommodated but also because this is one way in which additional street capacity for vehicles can be obtained. It may be assumed that convenient rapid transit service will be provided if a prospective passenger is not required to walk much more than half a mile to reach a rapid transit line routing towards the business center, which is the objective point for most of the traffic. Most people can walk a half mile in ten minutes. On this basis of planning the rapid transit lines will be about a mile apart in the residential districts, but as they approach the center they will route closer together, to the extent of traversing every street in extreme cases. For crosstown service in the outlying sections rapid transit lines two miles apart will conveniently serve the community. At the center the crosstown lines must be closer together. They must be close enough to provide sufficient transfer capacity, as capacity and not convenience is the controlling factor in such location. When its transit program conforms to this standard of convenient service New York City will have been provided with a complete rapid transit system, and in effect its surface car system will have been replaced by a rapid transit system, as must be the case to relieve surface congestion.

In the development of the plan every collecting and distributing branch traversing The Bronx, Queens, Brooklyn and Richmond is routed into and through the center in Manhattan—assumed to include that portion below 59th Street. In other words, all transit lines, wherever they may originate in the outlying boroughs, enter and traverse the center, so as to afford the same degree of accessibility to this 8 sq. miles from all of the 315 sq. miles constituting the whole city. The circumstances demand this. But it would be better if other centers could be created and thus avoid focusing the active life of the entire community in one area.

In the case of the lines serving Richmond—Six two-track collecting and distributing lines—three of the lines reach the center in lower Manhattan by way of Brooklyn. The first Richmond lines should not only provide transit for Richmond, but also should traverse and serve Brooklyn.

The other three, those for later development, reach the center by way of New Jersey.

As far as it has been practicable to do so every trunk line traversing the center in Manhattan is connected at both extremities with collecting and distributing branches in such a way as to develop a two-way traffic, thereby utilizing such trunk lines for the movement of fully loaded trains in both directions during each rush hour, in this way making use of the street system through the center to its maximum capacity for rapid transit service. Even under such conditions, however, practically every north and south avenue through the center of Manhattan will be utilized by rapid transit lines.

Two-Story Subways—In some cases it is proposed to utilize the north and south avenues for rapid transit purposes to a greater extent than ever before contemplated. It is necessary to do this because there are not enough up and down avenues available for trunk lines. From the City Hall to 125th St., including Broadway, there are only eleven through avenues. Two avenues, Sixth and Seventh, are cut off by Central Park, with no population to serve and with lakes and reservoirs to build under. Above 125th St. there are still fewer through avenues. The eleven through avenues connect and serve about 150 effective crosstown streets to 125th St. Expressed in another way, Manhattan from the Battery to Spuyten Duyvil has approximately 100 miles of north and south thoroughfares to serve approximately 325 miles of crosstown streets—or the ratio of crosstown to longitudinal streets is over 3 to 1.

These conditions explain the inordinate congestion which exists along all north and south travel lines. Consequently, since the avenues are too few in number, it is proposed to multiply their use underground. In the case of Eighth Ave., a two-story eight-track subway is proposed. In the case of another, Madison Ave., a two-story six-track subway is proposed. All of the tracks in these two-story subways will probably not be constructed at the same time. Some new lines will have to be provided soon on the west side and some on the east side of Manhattan. Probably two-story lines will have to be started in Eighth Ave. and in Madison Ave. at about the same time, but with only two tracks in each story, provision being made in locating the line in the street and in constructing it so that the remaining tracks can be added later on.

An effort has been made to bring the trunk lines throughout the center as near the median line of Manhattan as possible. In this manner the majority of the rapid transit lines through the center south of 59th St. is contained within the section between North Ave. on the west side and Lexington Ave. on the east side. The trunk lines are routed north and south in as straight lines as practicable, which will at the same time permit them to be brough closest to the median line.

Moving Platforms—Loops within the center are objectionable because they segregate traffic to such an extent as to create a menacing congestion of all kinds—pedestrian, vehicular and transit congestion. The best way of providing convenient crosstown connections between all lines is by means of a number of crosstown lines routing practically from river to river. Surface lines may be utilized at first if proper transfer arrangements are effected. But where the traffic is dense, in order to relieve the street for other uses and to accelerate transit movements, the railway traffic should be placed underground. It is believed that the most desirable way of furnishing such crosstown connections is by means of underground moving platform lines.

21 *Two-Track Tunnel Crossings*—At the present time there are 34 single-track river crossings connecting Manhattan with The Bronx, Queens and Brooklyn. The proposed plan contemplates adding 42 single-track river crossings. All of these crossings will be by means of tunnels. This means, therefore, that the comprehensive program includes 21 additional two-track tunnel lines under the waters surrounding Manhattan and connecting Manhattan with The Bronx, Queens, Brooklyn and Richmond.

830 *New Single-Track Miles*—The proposed new routes have not been studied in detail. It is therefore impossible to say how much of the mileage will be underground mileage and how much of it elevated mileage. The total new mileage, including the new lines, extensions and moving platforms, and including the third tracks, amounts to about 830 single-track miles of additional rapid transit facilities. The Dual System has 616 miles of single track. The proposed new facilities therefore would considerably more than double the Dual System mileage. The third tracks do not traverse the center and therefore do not add materially to capacity, but they permit of decreasing the time of travel between the outlying limits and the center. Twelve extensions to the existing lines are proposed.

31 *Additional Subway Tracks Through Center*—The Interborough east and west side trunk lines contain four tracks each, or eight tracks altogether. At the present time only six of these eight tracks carry loaded trains through the center during the rush hours. Relatively empty trains travel over the other two tracks. In other words, only two pairs of these tracks develop a two-way traffic; the other two pairs develop only a one-way traffic. It is proposed at some future time to connect up the two one-way traffic pairs to Brooklyn, thereby transforming them into two-way traffic pairs, and in this manner obtain an additional two-track capacity through the center during the rush hours. Similarly it is proposed to extend the pair of tracks of the New York Municipal four-track trunk line which now terminates at 59th St. into upper Manhattan so as to secure another full capacity movement through the center, which with the two Interborough full capacity movements will add three new full capacity movements altogether.

At the present time traversing the center north and south there are 7 trunk lines, consisting of 20 tracks (excluding third tracks). There are proposed 6 new trunk lines, consisting of 28 tracks, thus making a total of 13 trunk lines, consisting of 48 tracks, running north and south in Manhattan through the center. The three new full capacity movements, with the 28 new tracks which are proposed under the comprehensive plan, will furnish 31 additional full capacity tracks through the center, all connected with collecting and distributing branches running out into and through the outlying sections of all of the boroughs.

New Trunk Line Tracks

Although it is not possible to look ahead to the end, it is practicable to see forward to the near future. For the year 1920 the total traffic on all transportation lines—surface, subway and elevated—will amount to about 2,400,000,000 passengers. If 25 years from now 5,000,000,000 passengers must be accomodated, and most of them on rapid transit lines, it means that enough facilities must be added to serve 2,600,000,000 passengers. Eight new trunk line tracks through the center with collecting and distributing branches running out from their extremities would be sufficient to do this. Supplementing the new trunk lines, three crosstown moving platforms should be constructed to supply proper distributing facilities throughout the center. Also, two of the existing one-way traffic lines should be extended north or south, as the case may be, in order that their full trunk line capacity through the center may be utilized.

The following extensions and new routes are recommended for early construction to meet the next 25 years' requirements.

Extensions—The first new work that will have to be carried out will probably be certain extensions or additions to the existing lines, as follows:

Extension of the Corona branch of the Steinway Tunnel line from its present terminus to Main St., Flushing.

Extension of the Steinway Tunnel line, from its proposed terminus at Seventh Ave. and 41st St. west through 41st St., to a connection with the proposed Eighth Ave.-Amsterdam Ave. trunk line, as already described.

Two-track extension of the New York Municipal Railway Corporation Broadway-Fourth Ave. Trunk line, from 59th St. and Seventh Ave. up Central Park West and Eighth or Seventh Ave. to the Harlem River.

Extension from the New York Municipal Railway Corporation Broadway-Fourth Ave. subway, at Broadway and City Hall Park, via Ann St. and the East River to Brooklyn, and thence via Brooklyn Bridge terminal property, Washington St., Livingston St., De Kalb Ave. and Fort Green Place to a connection with the Fulton St. elevated line at or near Ashland Place. This connection has already been under consideration.

Two-track tunnel under the Narrows connecting the southern extremity of the Broadway-Fourth Ave. line of the New York Municipal Railway Corporation with the Borough of Richmond, providing the first rapid transit facilities for this borough.

Continuation of the Nostrand Ave. subway of the Interborough Co. south into and through Coney Island.

Crosstown line through Queens and Brooklyn connecting the Astoria branch in Queens with the Brighton Beach line in Brooklyn, thereby providing a crosstown line between Queens and South Brooklyn, and being a part of the proposed Brooklyn waterfront crosstown line previously described.

Extension of the two tracks of the Interborough Seventh Ave.-Broadway line now terminating at the Battery, from a point at Greenwich and Liberty Sts., via Liberty St., Maiden Lane and the East River to Brooklyn, and thence via Hicks St., Union St., Seventh Ave. and Gravesend Ave. to a connection with the Culver line.

Also some minor extensions to the elevated lines where such lines are not now routed to the city limits.

New Trunk Lines—In addition to the foregoing extensions the following new trunk lines will probably have to be constructed in the near future:

Serving the west side of Manhattan, four tracks of the eight-track Eighth Ave.-Amsterdam Ave. trunk line, extending from 155th St. in upper Manhattan to 23d St. in lower Manhattan, with a collecting and distributing branch from its northern extremity extending north through upper Manhattan and into The Bronx, and provision for an easterly branch, which later can be constructed east across the Bronx via 161st St., Longwood Ave. and Randall Ave. to Throgg's Neck, and with a branch from its southern extremity extending east through 23d St. to the East River, which subsequently can be carried across to Brooklyn, and with another branch extending south down Hudson and Washington Sts. to somewhere near the Battery, which subsequently can be extended to Brooklyn.

Serving the east side of Manhattan, four tracks of the six-track Madison Ave. trunk line, extending from the Harlem River to 23d St., with no collecting and distributing branch at the northern extremity, but with a two-track collecting and distributing branch extending from the southern extremity down Fifth Ave. and through lower Manhattan to some point near Park Place, the other two of the four tracks terminating at 23d St. and Madison Ave.

Moving Platforms—In order to provide sufficient transfer facilities across town between all of the north and south trunk lines to permit of the traffic reaching the center having easy access to any point within the center, three moving platform subways should be included in the program, namely, through 14th St., 42d St., and 57th St., practically from river to river, connecting all the up and down rapid transit lines.

The extensions, new trunk lines and moving platforms projected above will probably meet all of the rapid transit requirements for the next 25 years. The building program should be laid down in such a manner as to enable the beginning of construction of these lines as soon as possible, and so as to equally distribute their construction over this 25-year period in order that all of the facilities outlined may be available at the expiration of this period.

It is impracticable to estimate the construction cost of this 25-year program because of the long period over which the construction would extend. At pre-war prices, however, it is estimated that the construction program outlined would cost somewhere in the neighborhood of $175,000,000. At present prices it is estimated this cost would amount to $350,000,000. It is hardly likely that present costs will be greatly exceeded, so that the cost of carrying out this program will probably be somewhere between these two figures. These figures do not include interest during construction or engineering and superintendence.

Feeding Garbage to Hogs at Halifax, England

A profit of £400 ($2,000) from garbage-fed hogs at Halifax, England, during the past year is reported by the Street Cleansing Committee of that city. Feeding was started in a small way during the war but, according to the London *Surveyor*, "grew until 125 animals were in stock, pigs for killing being sold to local butchers." School children are paid "sixpence a stone" (12c. per 14 lb.) for garbage brought from their own and neighbors' homes. By this means over 20 tons (2,240 lb.) have been received, for which £82 ($400) has been paid.

Conveyors Speed Delivery of Sacked Coffee to Ships

Installation at Port of Santos, Brazil, Has Capacity, Per Unit, of About 3,000 Sacks Per Hour

By S. T. Henry

Vice-President, Allied Machinery Co. of America; Formerly Associate Editor, *Engineering Record*

FOR several years an extensive system of conveyor belts has been used successfully in the Port of Santos, Brazil, for transporting sacked coffee from warehouses 280 to 360 ft. from the dock to the decks of steamers alongside the latter. The installation is divided into several units. Each unit has a capacity to deliver 2,000 to 2,500 sacks, each containing about 200 lb. of coffee, per hour from warehouse to steamer.

Santos is the principal shipping port for Brazilian coffee. The amount of coffee that passes through this port has been from 5,000,000 to 7,500,000 sacks per year for the last five years. Shipments are made at various rates depending on market conditions, steamer space available and other factors.

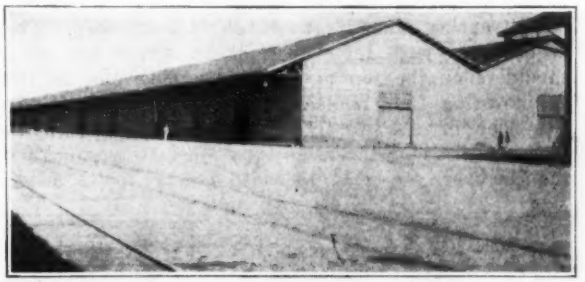


FIG. 1. TYPICAL DOUBLE WAREHOUSE AT SANTOS

The coffee is delivered to the port by steam railroad. Some of the shipments from the interior go from the railroad cars directly into the holds of the steamers. A large percentage of the shipments, however, are stored in warehouses along the docks awaiting the arrival of steamers or for various other reasons.

The warehouses are long, low buildings in rows parallel to the docks. The street to the left of the warehouse in Fig. 1 is about 140 ft. in width. On the left side of this street and close to the docks is a row of merchandise warehouses, Fig. 2, each about 100 ft. wide. Between the merchandise warehouses along the docks and the steamers is a space about 40 ft. wide, on which are laid railway tracks, and tracks for traveling cranes and bridges.

Less than half of the coffee stored in the warehouses is delivered by the conveyor belt installation from the warehouses directly to the deck of the steamers in which shipment is made. The warehouses that are equipped with conveyors each have a conveyor on the longitudinal center line between the two sections that make up a double warehouse. At the transverse center line of the building each longitudinal conveyor delivers to a cross-conveyor that extends under the street shown in Fig. 1. This conveyor under the street delivers to an inclined conveyor between the ends of the warehouses along the docks. The inclined conveyor extends from the conveyors under the street up to horizontal conveyor along the water side of the dock warehouse. Platforms on brackets which carry the conveyors along

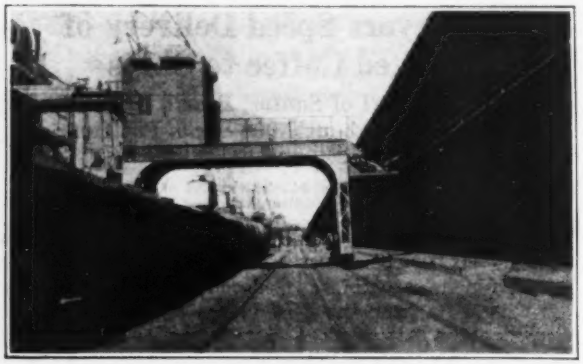


FIG. 2. RELATION BETWEEN CONVEYORS ALONG DOCKS AND TRAVELING BRIDGE

the water side of the dock warehouses also are shown in Fig. 2.

The conveyors on traveling bridges receive the sacks from the conveyors along the water side of the dock warehouses. The arrangement of these traveling bridges is shown in Figs. 2, 3 and 4.

The conveyors in the warehouses are in concrete-lined trenches about 6 ft. wide and 6 ft. deep. They are covered with removable planks which are set in shoulders on the top of the trench sidewalls, so that the covering they make is continuous and flush with the floor of the warehouse. The conveyors in the trenches are supported by fixed steel frames. All of the conveyors are 24 in. in width and are motor driven.

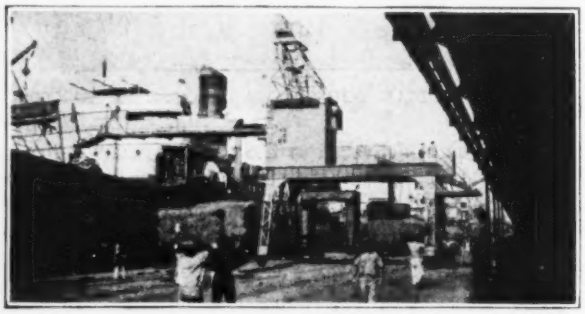


FIG. 3. DELIVERY OF SACKS BY CONVEYOR DIRECT TO DECK OF STEAMER

The conveyors under the street are in concrete-lined tunnels. They are also on fixed steel frames. There are four of these cross-conveyors in tunnels and four inclined conveyors connecting with those along the water side of the dock warehouses.

The total length of the conveyors on the brackets along the dock warehouses is approximately 1,800 ft. These horizontal conveyors are arranged to drive in one direction, but they are sectionalized so that each inclined conveyor delivers to either of two sections running in opposite directions.

Four of conveyor bridges (Fig. 3) are installed. All of them are of the same design. Each is arranged with a leaf which can be raised (Fig. 4) to clear the steamers, as shown in one of the photographs. The bridges deliver sacks to the deck of the ship, as shown in Fig. 3. From the deck of the ship the sacks are lowered into the hold on chutes by hand.

This installation of conveyors was made prior to the war. It has been in continuous operation since then. A careful inspection indicates that the maintenance has been low and that the upkeep is not serious. Canvas belts have been used in recent years because rubber belting could not be secured. The foreman in charge believes that rubber belting is much better for this service.

The only opportunity for improvement on the system appears to be in the handling of sacks in the warehouses. At present, men carry the sacks an average of 40 ft. to the conveyors in the trenches on the longitudinal center line of the warehouses. Portable conveyors on flat-wheel casters would eliminate all this carrying.

FIG. 4. CONVEYOR BRIDGE WITH LEAF RAISED

FIG. 5. SACKS ARE SOMETIMES LOADED BY HAND

All of the coffee not handled by the conveyors is carried on to the steamers by men, as shown in Fig. 5.

In studying the capacity of the installation, a unit was considered as the conveyors in one warehouse, the corresponding conveyor under the street, the inclined conveyor to which the street conveyor delivered, the corresponding two sections of the conveyor along the water side of the dock warehouses, and one traveling conveyor bridge. An observation of 27 min. showed, by careful counting, that one of these units was delivering at the rate of about 1,800 sacks of coffee per hour. That is, the unit could deliver that number of sacks from the warehouse to the ship in that time.

The foreman in charge claimed that the capacity of a unit is easily 2,500 sacks per hour, and that they have handled as high as 3,000 sacks per hour per unit. The capacity obtained apparently depends on the rate at which sacks are loaded on the conveyor in the warehouses and on the skill of the men who straighten the sacks at the points where one section of the conveyor delivers to the next section. It appeared that a unit could handle about 2,800 to 3,000 sacks per hour, if the men needed to align the sacks at the junctions would work with reasonable efficiency.

Engineering Courses for Ex-Service Men

A recent bulletin issued by the national service department of Engineering Council announces that the Federal Board for Vocational Education has arranged with engineering Schools in all parts of the country to give engineering instruction to 2,387 ex-service men, all branches of engineering being represented. As colleges and universities start courses for the current school year additional arrangements are being made.

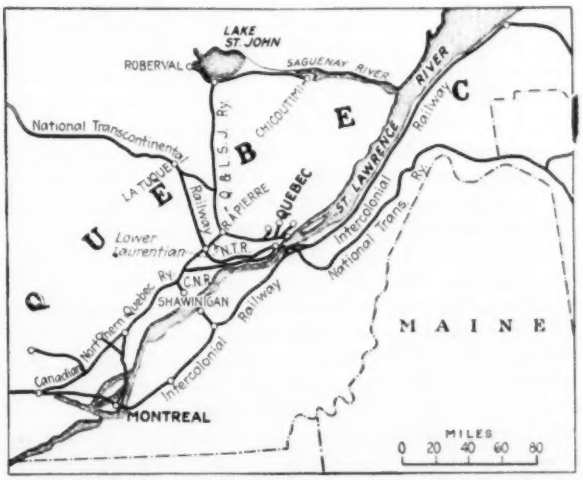
Location Betterments on Canadian National Railways

By Henry K. Wicksteed
Chief Locating Engineer, Canadian National Railways

PRESENT CONSTRUCTION and studies for location betterments on the Canadian National Railways may best be understood by a brief review of early railroad building on the Canadian Northern. The principal component of the lines composing the Canadian National System is that of the Canadian Northern. This was financed, designed, and built, as everyone knows, by the firm of Mackenzie & Mann, both members of which were not only very able business men and financiers, but had had a long previous experience in contracting on the Canadian Pacific, and an absolute confidence in the resources of Canada and its future. They knew personally a great many of the older engineers and others who had been identified with the construction of the older road, and they gathered about them a number of these men who knew the topography of Canada as no one else could know it, and the weak points of the older roads as well as the strong. Under these circumstances it is not surprising that the Canadian Northern from Montreal and Toronto to Vancouver, has the reputation of being the best long distance line on the continent in proportion to cost, and the best on this continent from an economic point of view means the best in the world. Some day justice will be done to the extraordinary talent and vision of these two men. Public opinion is even now swinging round in that direction. The successful man has always a great crowd of detractors, but as successful man remarked to me a few days ago, it is easier to make and keep a reputation than to do things. These men attempted the impossible and got away with it. Two farmers' sons built 10,000 miles in less than 20 years.

Part of this system in the East was composed of acquired lines which were linked together and sometimes acted merely as feeders to the parent system; sometimes formed part of the main line itself. They had nearly all been finished years before, and in location features were not on a par with the somewhat higher standards demanded at the present day. One such road was the Bay of Quinte which was used with modifications for some 25 miles between Toronto and Ottawa. Grades of 1.5 per cent were reduced to 0.5 per cent, while the other construction was going on, and finished simultaneously, the stations being left in their original positions, and the existing business of the line being left undisturbed. A still more important link in the main chain between Montreal and Quebec was the Great Northern of Canada, completed about 1900, and itself composed of older roads coupled together. It extended originally from Hawkesbury on the Grand Trunk, 60 miles east of Ottawa, to Rivière à Pierre on the Quebec & Lake St. John, and was intended as an overflow route for the somewhat heavy flow of grain then going east from the Georgian Bay at Parry Sound to Quebec. One hundred miles of this route, from Quebec to the St. Maurice, was made up of two colonization roads, the Lower Laurentian and the Quebec & Lake St. John, and had a number of grades of 2 per cent, and curvature as sharp as 10 deg., in combination.

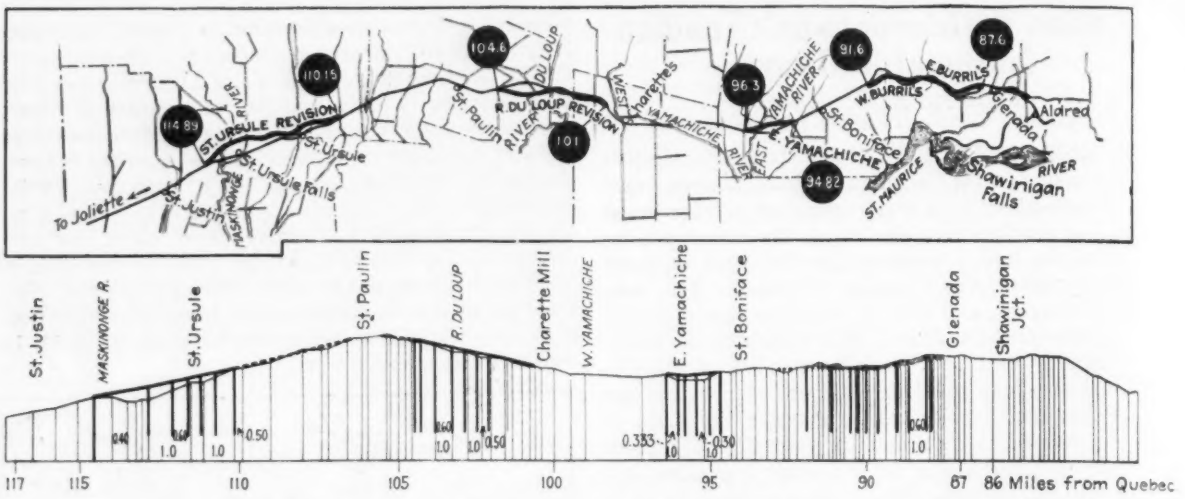
The newer portion had been built to a 1 per cent standard. The most objectionable part of this combination was eliminated by building a new line from the St. Maurice 80 miles to Quebec, which reduced the distance some 17 miles, and the ruling gradient from 2 per cent uncompensated to 0.60 per cent compensated. This provided for nearly one half the distance between Quebec and Montreal and two-fifths of that from Quebec to Hawkesbury. Nine miles of the remainder was taken up by a sharp drop into the valley of the St. Maurice, and an equally sharp rise on the opposite side, and of the remainder all but 30 miles was on the great Montreal plain, and where the grades were at all objectionable, they were all so short as to be easily reducible by ordinary steam shovel work.



QUEBEC NATIONAL RAILWAY SYSTEM

The St. Maurice depression, involving as it did the moving of a station and raising of a bridge over the river, has been left alone for the present, and is being worked as a special short division, but this 30 miles involving some long 1 per cent grades became one of the first studies of the Canadian National staff. Surveys showed that these could be reduced to 0.60 per cent by the construction of some 14 miles of new line, and 4 deg. curves substituted for the 8 deg. standard now obtaining, and that the capitalized value of the change would amount to some $5,000,000 or more, while the cost was estimated at $1,500,000, but this cost was largely made up by that of four steel viaducts over as many rivers. The existing bridges, which had been standing some 20 years, were none too heavy in the first place, and quite unequal to modern loads, and rebuilding them in the new sites was somewhat cheaper than in the old. The amount chargeable to grade revisions therefore, was less than $500,000 and it needed little argument to convince the directorate that the expenditure was a good investment. Work on these changes has actually been commenced.

Meantime the traffic on the Quebec & Lake St. John, a little separate system of 280 miles built as a colonization road, had grown very rapidly, owing to the development of the wood pulp and paper industry in the Saguenay basin, and its 1.5 per cent grades (and on the Quebec end 2 per cent), had become very expensive to maintain and operate. Most of this traffic goes to and beyond Montreal, and leaves the Q. & L. St. J. at R. a Pierre, running over the 40 miles of the Lower



BETTERMENTS UNDER CONSTRUCTION ON ST. LAWRENCE SUBDIVISION

Laurentian above mentioned with 2 per cent grades, and into the main line at the St. Maurice. The National Transcontinental, another member of the National System, crosses this midway between R. a Pierre and the St. Maurice, and this too is carrying more traffic to and from Montreal over this little one-horse colonization branch. Studies now being made for the reduction of these 2 per cent grades to the same 0.60 per cent standard are well advanced and very encouraging, but obviously in a reduction from 2 per cent to 0.60 per cent with considerable changes in elevation, it can not be expected that much of the old line will remain. It is possible, however, to retain all the stations and traffic points intact. Otherwise there would be a very serious rebellion among the good people of the province of Quebec.

Last in importance perhaps, and furthest away from the great trade centres, but among the most interesting of all, are the studies on the Quebec & Lake St. John itself. One hundred and twenty-five miles north of Quebec is the city of Chicoutimi. Many Canadians have never heard of it, and probably the great majority of Americans. Yet it is a seaport nearer to Europe than any in the United States. Within 50 miles of it are a million horsepower of water power or more, most of which is running to waste. Within 150 miles are some of the greatest spruce forests of the world, and at its doors, and extending more than 50 miles, are 1,000 square miles of good agricultural land. In this city, and on this land, are 50,000 to 60,000 industrious and thrifty French Canadians. From Canada, the United States, and both England and France, capital has come freely in the past, and is still coming for investment in pulp grinding and paper making. To the westward, and tributary to this city are mineral areas which have caused at least one flurry of excitement. Quebec has perhaps the sanest population, and the most progressive and business-like government of any province in Canada. This combination is a hard one to beat, and many people are realizing it. One chance acquaintance on the train in midwinter had come all the way from Kansas City merely to look into the chances for profitable investment.

Under these circumstances, it is only natural that the traffic on the Quebec & Lake St. John should increase, and that it should look forward to economic development and improvement in grades and curvature, and possibly, in the more remote future, to electrification. At every few miles along its line are rivers with minor waterpowers which can be developed easily and cheaply. Few of them perhaps are large enough to justify a transmission line to distant localities, but quite large enough in the aggregate to keep a railway going, and probably so evenly distributed that a high tension line and converters would be unnecessary. This matter of electrification of Quebec lines will soon be well worth studying, but the question of grade reduction and increasing at moderate expenditure the train load by 50 per cent and sometimes over 100 per cent, remains relatively just as important. Electrification will reduce or nearly eliminate the coal bill. Grade reduction will reduce both coal and wages in proportion to tonnage. Both expenditures will probably soon be worth while. The accompanying plans and profiles show some of the most interesting of the problems under construction and study.

Sewage Sludge Utilization at Glasgow

More extensive utilization of sewage sludge from the chemical precipitation works of Glasgow, Scotland, is proposed, according to the London *Surveyor*. All the sludge from the works at Dalmuir and Shieldhall was sent to sea last year but the larger part of that produced at the Dalmarnock works was pressed and sold to famers. The Dalmarnock sludge yielded a revenue of about £2,000 ($9,730) last year. By pressing all the sludge at Dalmarnock this year it is expected that the revenue will be increased by £1,200. Changes under way at the Shieldhall works will save the city £7,000 a year as compared with the cost of sludge disposal at sea. If similar changes were made at the Dalmuir plant a further saving of £10,000 would be made. One reason why these changes have been delayed, the *Surveyor* says, is that heretofore "an economical price could not be obtained for the manure, but now" the city "could get readily 4s. (about $1) per ton instead of the market price of 1s. per ton which ruled five years ago.

Notes from Foreign Fields

MAKING THE MOST OF LIMITED NATURAL RESOURCES IN HOLLAND

By E. J. Mehren
Editor, *Engineering News-Record*

HOLLAND is of much interest from the engineering standpoint. We know it as a picturesque country, a land of windmills, of wooden-shoe children, of rosy-cheeked girls, of scrupulous cleanliness, and of ever-present canals, but we do not, as a rule, appreciate that its engineering achievements are of a very high order. Nor do we realize from what meager resources the Dutch people have built for themselves an important place in the affairs and commerce of the world. Their land has an area of only 12,558 sq.mi., approximately the size of Massachusetts and Connecticut combined. About 25 per cent of it was once covered with water. About 13 per cent more is so low that it would be covered by every high tide, were it not for the dikes. On these unfavorable lands the Dutch people, with infinite patience, untiring energy and much engineering skill, have built up an agricultural industry rivaling that of any similar area in the world. For centuries Holland has been rising from the sea, until now, having reclaimed all land whose location would naturally lead to its reclamation, she has begun to turn back the sea on a grand scale. She has taken in hand the oft-discussed project of reclaiming the Zuider Zee.

But if Holland must contend with unfavorable land conditions, she has an advantage in location on which her thrifty and shrewd people have not failed to improve. Situated at the corner of the Continent she is a natural avenue of commerce for a rich and populous hinterland, while within her territorial confines a mighty river—one of the world's greatest commercial waterways, the Rhine—empties into the sea. To her come the Rhine argosies. She transships their cargoes and in turn sends them back laden with the products of Dutch colonies and of every country of the globe.

These two facts—the unfavorable natural condition of her land, and her fortunate commercial location—are the controlling elements in the engineering of the Netherlands. Her drainage practice—with the accompanying arts of diking and pumping—lead the world, while she is properly a Mecca for those who are seeking data on the design and operation of ports and harbors.

These do not, of course, exhaust the list of interesting engineering developments in Holland, but they are the ones that will get the most attention from the visiting engineer.

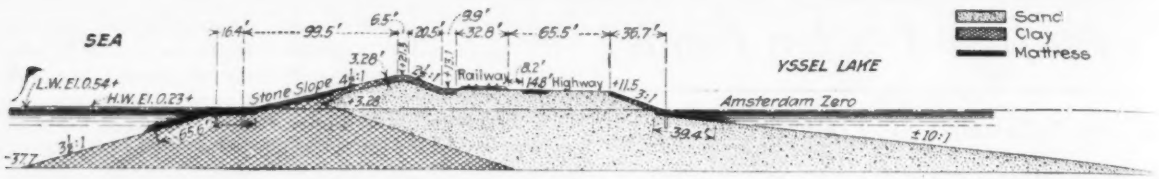
Drainage—Land drainage, of course, is not an unknown art even with us, but it is carried out in Holland under far more difficult conditions than in the United States. True, there is much land at about their Amsterdam zero—average high water level at Amsterdam—which is relatively easy to handle, but that which was formerly covered by lakes or the sea lies from 3 to 5 m. below average high water level. Hence the wind mills. In the Haarlem Meer polder ("polder" is the name given to a reclaimed area), for example, the land is at an elevation of –4.25 m. (–14 ft.). The water levels in the polders are kept from 50 to 75 cm. below the ground surface, so that the maximum pumping lift at high water would be about 5.75 m. (about 19 ft.).

CANALS IN AMSTERDAM

The drainage is effected by systems of canals, with principal branches about ½ km. apart. From these laterals run off, about 75 m. apart. Where necessary, tile drains are laid between these laterals.

Pumping was done formerly entirely by windmill, but steam and electrically driven pumps were introduced many years ago and are gradually supplanting their more picturesque but less economical predecessor. The windmill, however, is not by any means fully superseded. In fact, at one polder I visited, the Schermer, the pumping is still entirely done by wind power and there are no less than 55 mills at work on the unwatering of this 4,445-hectare (11,000-acre) polder. The reclamation of this area, by the way, dates back to the year 1635.

The windmill design has been little changed in centuries. A typical mill that I inspected in the Province of North Holland had a sail area on each of its four vanes of about 67 sq.ft. The pump itself was a wooden spiral, with an outside diameter of 2 m. (6½ ft.) and a pitch of about 2 ft., set on an incline of probably 30 deg. The shaft attached to the vanes, and the vertical shaft transmitting the power to the pump were of timber, as were the pinions at top and bottom of the vertical shaft. At the Schermer polder the pumping



CROSS-SECTION AT MAXIMUM DEPTH, ZUIDER ZEE DIKE

was done in three lifts (by three sets of mills), each lift being of 1½ m., the polder water level being, at most, 4½ m. below the Amsterdam zero.

The high cost of windmill pumping is due to the cost of attendance. Each mill has its own operator, who makes his home, with his family, in the mill tower. In the steam and electric pumping plants, obviously, the cost of attendance per 1,000 cu.m. of water pumped is but a small fraction of that of the windmills.

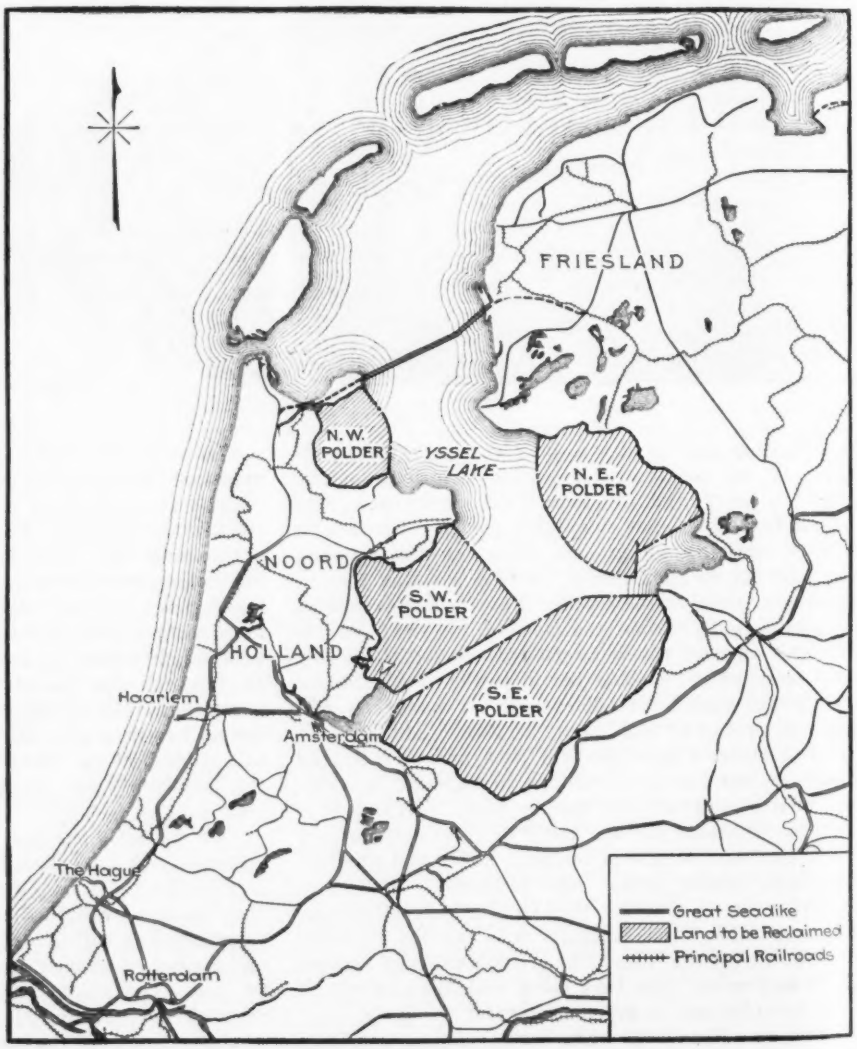
As previously noted, steam and electric power are now much used for pumping. The pumps would form an interesting study for those interested in the history of pump development. There are scoop wheels of various types, centrifugal pumps, and screw pumps, the last of the type designed by A. B. Wood, of New Orleans, and first installed in the drainage pumping plants of that city. Electric pumping capacity is provided on the basis of removing 10 cu.m. of water per minute for each 100 hectares in the polder, figuring that the pumps will operate 18 hr. per day. This is the normal basis. If there is much water area in the polder, the capacity need not be so large, on account of the reservoiring effect of the water areas. Because of the reliability of steam power, steam pumping plants are generally figured on the basis of operating 24 hr. per day.

Manual Control

Most of the plants are manually controlled, but there are some automatically controlled electric pumping stations. The equipment has not a heavy load factor, operating only 1,000 to 1,200 hr. per year.

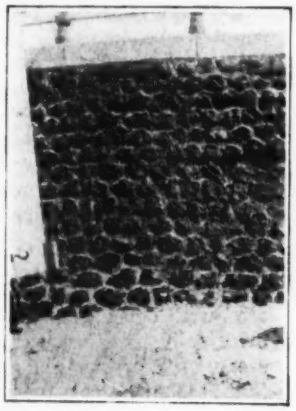
The dikes are built of sand or loam, with a clay protection ranging from 50 to 75 cm. thick. One dike I saw on the Zuider Zee had a height of 4.5 m., a top width of 1.5 m., a sea slope of 2 on 1, and a back slope of 3 on 1. The sea slope, in addition to the 75-cm. clay covering, had the following protection—two courses of hand-placed brick, a course of broken brick to act as bedding, and then basalt blocks 40 to 60 cm. high and 8 to 12 cm. through, placed on end and brick or stone chinked. These basalt blocks, by the way, are much used in Holland for slope protection and the facing of sea walls. They are of the typical columnar basalt, having the cross-section of irregular polygons, and are imported from Germany.

Zuider Zee Work—Much interest naturally is taken in the reclamation of the Zuider Zee. The project has been under active discussion for seventy years and in July of this year work was actually taken in hand. The most striking feature is that the entire area back of the great dike is not to be reclaimed, but is to include a large lake as well as the new polders. The total area affected will be 360,000 hectares (889,000 acres), of

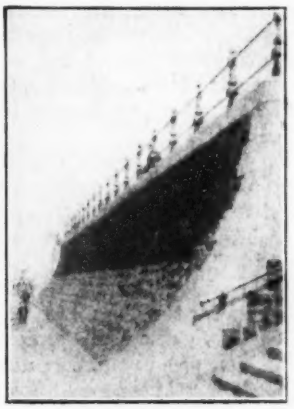


1. AREAS TO BE RECLAIMED FROM THE ZUIDER ZEE

which 215,000 hectares (531,000 acres) will be reclaimed and the remainder 145,000 hectares (358,000 acres) will remain as lake. The great dike will have a length of 30 km. (18 miles) divided by the Island of Wieringen (see map herewith) into 2.5 and 27.5 km. lengths. The average depth of the Zee on the line of the dike is 4.14 m. (12.57 ft.) below the Amsterdam zero and 3.6 m. (11.8 ft.) below ordinary low water level. The greatest depth below the Amsterdam zero on the line of the dike is 11.5 m. (37.7 ft.). A cross-section of the proposed dike at the maximum depth is shown herewith. It is on this section—between Wieringen and the Province of North Holland—that work is now under way.



BASALT-BLOCK FACING FOR SEA WALL



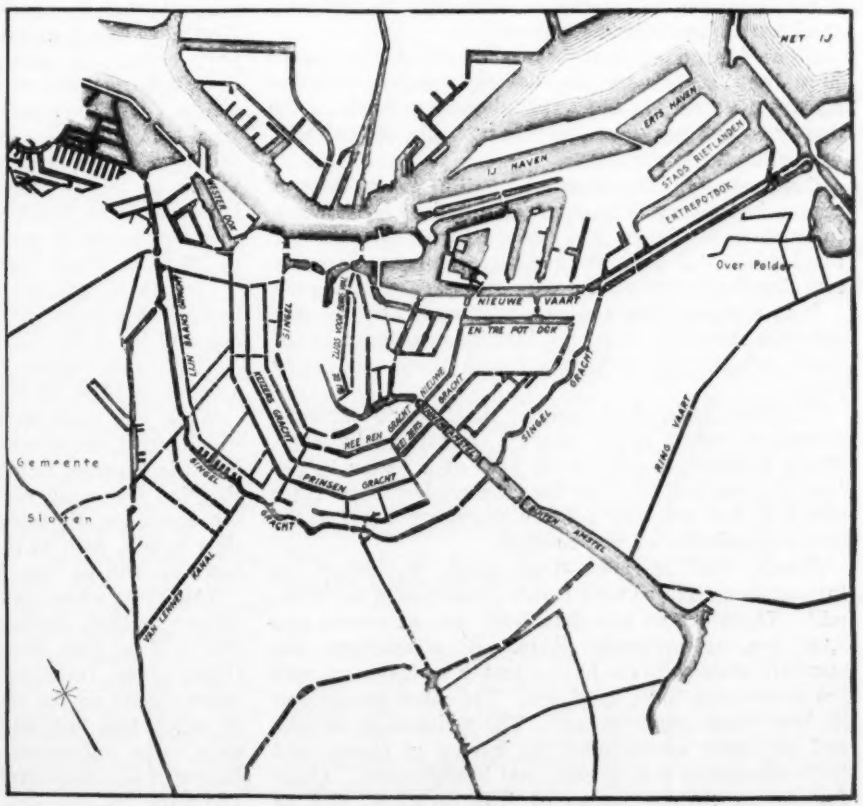
SEA WALL AT SCHEVENINGEN WITH BASALT-BLOCK STONE

The maximum elevation of the great dike is 6.5 m., while the highest water level, at storm tide, is 3 m., both above the Amsterdam zero.

In the area to be drained the sea bed is at an elevation of 3 to 4 m. below the Amsterdam zero, and since the shrinkage of the soil when unwatered is about 1 m., the dry land will be from 4 to 5 m. below ordinary high water.

The decision to allow approximately 40 per cent of the area back of the great dike to remain covered with water was reached only after long study. The areas bordering on the Zuider Zee are deficient in supplies of fresh water. During midsummer it is sometimes found necessary, as a last resort to save crops, to admit brackish or sea water to the polders. This is detrimental to the land and has been followed by diseases of stock. Since the Yssel Lake (as the new lake will be called) will receive the discharge of the Yssel River, one of the mouths of the Rhine, and several small rivers that now flow into the Zuider Zee, it will in time be changed into a fresh-water lake. Then, in times of drought, irrigation water can be admitted from it to the polders, while the communities in the neighboring provinces will be able to draw their water supplies from it. The Yssel takes about one-ninth part of the total flow of the River Rhine and has a maximum discharge of 2,000 cu.m. per second. It is proposed that the level of Yssel Lake shall ordinarily be kept at —0.40 m. (referred to the Amsterdam zero) and that its highest level shall not be more than +1.00 m. Since ordinary low water at Wieringen, where the discharge sluices into the sea will be located, is —0.54 m. and the ordinary high water level +0.23 m., it will be seen that the level of the lake can be maintained entirely by gravity discharge into salt water. Storm tide can prevent discharge by sluicing for a maximum period of only three or four days.

It is obvious that it would have been possible to inclose the areas to be reclaimed without constructing the great dike, but this would have made it necessary to build the bounding dikes of a section to resist storm tides from the North Sea. Their additional cost would have offset to some extent the saving caused by eliminating the great dike. Moreover, the great advantages of having a body of fresh water would have been lost. The keeping of storm tides away from the polder dikes has the great additional advantage of lessening the danger of breaching, and this is an important feature because of the great destruction of human life and property values sure to result from the breaking of a



CANAL SYSTEM OF AMSTERDAM—THE NORTHERN VENICE

dike. In the past Holland has had some bitter experiences with dike breakages and the insurance afforded by the great dike is not a negligable item in the considerations. Finally, the lower and more constant level of Yssel Lake will cheapen the cost of pumping water from the polders.

The map shows the location of the sluices—east of the Island of Wieringen. The plans call for twenty-five sluices, each 12 m. wide, so that there will be a sluicing length of 300 m., or 984 ft. The bottom of the sluices will be at an elevation of —4.40.

Pre-war estimates of the cost of the work were 40,000,000 guldens ($16,000,000) for the great dike, and 230,000,000 guldens ($92,000,000) for the whole project. The cost per hectare would have been approximately 1,100 guldens ($440), or about $180 per acre. Costs now are between two and three times what they were before the war, but before the work has progressed far prices will probably be lower.

The work now under way, on the 2½-km. length of dike between the Province of North Holland and the Island of Wieringen, consists in depositing in the deepest channel clay obtained by ladder dredge in nearby areas of the Zuider Zee. It is hauled to site in bottom-dump barges. Fortunately there are large areas of clay available, overlaid by about 1 m. of sand.

Conditions are not so favorable, however, as to the supply of willows for mattress work and stone for the paving of the slopes. Willows grow naturally on some of the low islands in the Zuider Zee, but the natural growth is insufficient for the needs of the work. For that reason 500 hectares have been planted to willows adjacent to the Zee, and an additional area of 500 hectares is to be set out as rapidly as possible. It takes about three years for willows to mature so that they can be used for mattress purposes.

Stone for paving is to be basalt, and arrangements have been made with the German quarries for the necessary supplies. In fact, the speed with which the dike work can be prosecuted will probably be controlled by the ability to get basalt.

Obviously, as the closure of the great dike is approached a very difficult problem will be encountered in handling the large tidal flow. Erosion of the sandy sea bottom will be prevented, according to plans, by covering the bottom with mattresses weighted with rock.

It is expected that the construction of the sea dike will take about ten years, and that the completion of the entire project will require between thirty and forty years.

The magnitude of the project itself would naturally command interest in any country, no matter how large. When, however, it adds to the area of a nation 6½ per cent, one can well imagine the transcendent importance which it has not only for the engineers but for the entire population of the country.

Canals and Harbors—The canal is almost as intimately associated with Dutch scenery as is the windmill. There are no less than 3,600 km. of canals, and 1,000 km. of navigable rivers. By comparison, the standard-gage railways have a length of 3,400 km. and the meter-gage lines, 2,500 km. The canal system had its beginnings centuries ago. The reclamation of lake and sea areas necessitated the leaving of canals, and their subsequent enlargement and improvement. These formed an obvious means of transportation, and as population increased played an important part in the country's economic life. Even today, with an adequate railway system, the water-borne traffic is extensive. The canals have a minimum depth of 3 m.

The existence of the canals naturally stimulated extensive development of canals in the cities and towns. They tap every quarter of the cities and afford means of delivering cargo by water. Amsterdam in particular is well supplied with canals and may be called a northern Venice. A plan of the city, herewith, shows the extent of the canal system.

The ports of Amsterdam and Rotterdam are especially well developed. Amsterdam's business consists principally in the transference of freight between oceangoing vessels and either railway or barge. For that reason the port design follows that of most of the other large European cities; that is, the vessels tie up at piers, which are amply provided with cranes and other transshipment equipment. The piers are planned on a very broad basis. In view of the inadequacy of pier design in the United States, as exemplified by the Staten Island piers, it was interesting to hear the manager of the port remark that a width of 100 m. was not sufficient. The width determined as the minimum in Amsterdam is 150 m. (492 ft.), and this width will be used in the coming extension of the port on the west side of the city.

Rotterdam is chiefly a port of transshipment between ocean-going vessels and the barges navigating the Rhine. For that reason basins are provided at which the ocean-going vessels tie up at buoys and pile clusters. Transshipment devices for handling grain, coal, and miscellaneous cargo have been developed to an elaborate extent.

Amsterdam is connected with the North Sea by the North Sea Canal, which is about 24 km. long, the greater part being the canalization of the Ij (*pronounced eye*), a former arm of the Zuider Zee, which was closed off by a dam just east of Amsterdam, when the canal was built. At the same time the remaining parts of this arm of the sea were reclaimed and form what is known as the Ij polders. The canal has a width on bottom of 50 m., is 9.8 m. deep, with side slopes of 3 to 1. It is now being deepened to 15 m. and is to be widened to 100 m. on the bottom.

The maximum tidal range is 3 m. and to control the levels in the canal locks are located at both the North Sea and the Zuider Zee ends. The largest lock at the North Sea end is now 12 m. wide and 225 m. long, with a depth of 10 m. of water over the sills.

Work has just been started on an immense lock, which, with the widening and deepening of the canal itself, is expected to provide for the largest oceangoing shipping for many years to come. The lock will have the enormous dimensions of 50 m. width and 400 m. clear length, with 15 m. of water on the sills. The lift, however, will be only 3 m.

This tremendous lock will be built in the wet by the caisson method, similar to that used at Pearl Harbor. This will be done because a number of the important Dutch cities, including Amsterdam, depend for their water supply on the water accumulations in the dunes, in which this lock will have to be built. If the site were to be cofferdammed and pumped there would be danger of seriously affecting this underground reservoir. The work has only now been taken in hand, but should

develop much of interest to the engineers interested in canal and lock work all over the world.

The engineers in charge of the canal and the lock are well known in the United States, both of them having been in America to study our canal practice. HEER G. S. VAN DEN BROEK is in charge of the canal, and JHR. C. E. W. VAN PAHHUYS in charge of the lock.

Roads—Despite the fact that traffic is light, the highway system of Holland cannot be said to be in good condition. This, however, is not a reflection upon the Dutch engineers, in view of the very bad soil conditions with which they must deal. The land lies low and the water in general is near the surface. In addition, many of the roads are on a soft peaty foundation.

As in most of the European countries, there is a national highway system. It consists of about 2,000 km. of road, paved with brick in the western portion of the country, gravel in the east, and macadam in the south. By far the greater length is paved in brick, the individual units being 6 cm. wide, 22 cm. long, and 11 cm. high, laid on sand. There are some stone roads, built of imported block, but, on account of the soil conditions, they have not given good service. Such of the macadam roads as I saw—and the mileage of them is relatively short on the national system—were in good condition. I did not get into the country where gravel was used. In general, the government roads are 5 m. wide. The secondary highway system is under the control of the provinces and the tertiary system under the control of the communities and the polders.

One unusual feature is that the highway engineer must provide a path for the bicyclist. The ratio of bicycles to population is probably higher in Holland than in any other country in the world. There are no less than 1,200,000 bicycles in the population of 7,000,000. On the other hand, there are only 6,000 passenger automobiles and 2,000 motor trucks.

There is agitation in favor of an extension of the government highway net and of its improvement by bettering and widening the surfaces. A 7½-m. carriageway is being strongly urged, with adequate provisions, in addition, for both footway and bicycle paths. Widening is in progress in a number of places.

Industrial Conditions—In general industrial conditions in Holland are good. Like all other European countries, Holland felt the pressure of the war, prices being now three times as much as they were in 1914. Labor has, on the whole, had increases proportionate to the increase in the cost of living, but the middle class, as elsewhere, has been pinched. The efficiency of the workers is somewhat better than in other countries of Europe, the opinion being that production per man is 70 to 80 per cent of pre-war production. On Oct. 1 the 8-hr. day goes into effect, by law, in certain trades, and the intention is to extend its application year by year.

I was interested to learn that there is a cleavage in labor along religious lines. The Christian unions (both Catholic and Protestant) apparently have been much more reasonable than the Socialist and Communist unions. They have, for example, no objection to working more than 8 hr. a day and have not objected to piece work. The other unions, on the other hand, have wanted an 8-hr. day. The Socialist unions work piece work though their leaders are opposed to the system while the Communist unions are strongly opposed to piece work.

Engineering Interest—When planning my trip I was in grave doubt whether I should include Holland in the itinerary. Its engineering works were less known to me than those of any other country that I had considered visiting. Did emergency require it, therefore, I had planned merely to pass through Holland without stopping. However, I am glad that I spent time there. Not only did I find the engineering works of great interest, but a hospitality and an understanding of Americans and American conditions that were second to none that I met in Europe. I found the Dutch engineers close students of American practice, and admirers of the way American engineers and contractors take hold of their engineering enterprises.

In the hope that my own experience in visiting Holland will be duplicated, I would most earnestly urge upon engineers who plan visiting Europe to include Holland in their itineraries.

The Hague, Aug. 4.

Macadam Roads Given Skin Coat of Tar Good After Nine Years

IN RECONSTRUCTING macadam or gravel roads the South Park Commissioners of Chicago have developed and perfected a method of applying a skin coat of hot pitch, which after nine years under heavy traffic conditions is still in very good condition, according to Harry S. Richards, superintendent of maintenance, South Park. While these roads have been described before, the long period of their service is warrant for a recounting of the methods used in their construction.

The old macadam was loosened with a spike wheeled road roller and then scarified and harrowed. This process tends to bring the larger pieces of metal to the surface. The road is then brought to the desired grade and compacted by the use of a 10-ton roller.

On this surface was spread a layer of crushed stone between 1½ and 2 in. in diameter, which was thoroughly compacted by means of the roller mentioned above. After the voids were completely filled with limestone screenings the road was sprinkled and rolled in a manner exactly similar to that followed in constructing the ordinary macadam type.

Before the surface treatment is applied, it has been found to be the best practice to throw the surface open to traffic for a week or ten days. At the end of this period it is traversed with a horse-drawn revolving broom which prepares the surface for the reception of the skin-coat treatment, which consisted of hot pitch applied under pressure at the rate of ¼ to ⅓ gallon per square yard, and at a temperature of not less than 250 deg. Before this pitch has cooled it is covered with ¼ to ⅜-in. chips of limestone, or gravel of equal size. The final touch is given by thorough compaction with a roller weighing about five tons.

Safety and Sanitation Not a Park Purpose

The New York State Court of Appeals has decided that the leasing of the Arsenal Building, in Central Park, New York City, to the Safety Institute of America for use as a safety and sanitation museum, would be a diversion of a portion of the park from its legitimate use for park purposes.

LETTERS TO THE EDITOR

Against the Federation

Sir—In the hope of somewhat clarifying the situation in regard to the proposed federation of engineering societies in the minds of members of the national technical societies, especially those like myself who are members of both the American Society of Civil Engineers and the American Association of Engineers, the following observations are offered:

The aims of the proposed federation have been advanced fully and need not be repeated here. The engineer is a professional man and as such demands the maintenance of the highest possible technical standards. For this purpose the founder societies have come into being and have functioned. If engineering is to be an advanced profession the scientific basis must be constantly expanding and advanced ground must be continually broken. This work is largely in the hands of the founder societies—stimulating research work and bringing to attention the most progressive achievements of engineering. Such work, it has long been considered, is best done by separate societies devoted to the different branches of the profession. Engineers have, however, another great field of interest; namely, that involving their responsibilities as citizens, service to the engineer in the way of increasing his prestige, support of their fellow engineers in all matters affecting public or professional interests, employment service, etc., including the protection of the public and the profession by their influence on legislation. It seems to be the well-meaning object of those advocating the federation to set up machinery to accomplish this.

That the American Association of Engineers as an organization favors any agency aiming to accomplish these results is shown by the fact that it has offered its hearty co-operation to the promoters of the federation. The letter of its secretary, C. E. Drayer, to R. L. Humphrey appearing on p. 62 of *Engineering News-Record* of Sept. 23, 1920, makes this fact clear. I can see no reason for any member of the American Association of Engineers who is not also a member of a founder society opposing the federation. However, when one comes to study the matter as a member of both American Association of Engineers and a founder society or even as a member of a founder society who is informed as to the organization, aims and accomplishments of the American Association of Engineers, we have a horse of another color. The founder societies are organized and functioning now in their chosen and broad fields and no doubt can and will rise to greater heights of accomplishment. The American Association of Engineers is a national organization, organized for non-technical work, to assist the engineers to perform their many civic obligations, to watch and direct legislation affecting our particular field, raise the prestige of the profession in public esteem, obtain proper recognition of engineering employees by employers and co-operation between them, welfare work including employment service, etc. A study of its records will disclose that this work is being advanced successfully and in a manner consistent with highest ethics, having adopted a code of ethics for engineers probably unequalled, having taken a determined stand against unionism in the profession, and having given service to the young men which is stemming the wave of unionism threatening the good name of our profession. This organization has now, I believe, about 21,000 members. It aims to be practically all-inclusive; it is soundly organized, functioning freely, democratic, effective and of high tone. Therefore, why embark on a new adventure hazardous on account of its absolutely unsound plan or organization, expensive in any case (with its sound and effective organization the American Association of Engineers is finding it difficult to give the best service at $10 entrance fee and $10 dues); and last but most important: Why introduce an element into our founder societies which will absorb effort and interest which should be devoted to technical development, threatening the consuming of much time and courting the probability of many serious dissensions?

Members of founder societies: The high prestige of your society so dear to you is at stake. Your pocketbook is in danger of a raid.

Members of the American Association of Engineers who are members of a founder society: You are now supporting two organizations which should and I believe will cover the full needs of the profession as far as can be served by organization and you are now being asked to support a movement which at best, it seems to me, represents simply a duplication of the work of the American Association of Engineers.

ROBERT H. JACOBS.

New York City, Oct. 9.

Oppose Am. Soc. C. E. as Federation Member

Sir—The American Society of Civil Engineers is now facing what is probably the gravest question that has ever come before it. It must decide whether it is to retain its position as one of the foremost engineering societies in the world or whether it is to surrender its prestige and influence into the hands of a new and untried organization of no professional standards and of vague purposes, in the management of which the Am. Soc. C. E. would have an insignificant and inequitable voice.

We cannot afford to dally with this proposal. The risk is too great. Once the Am. Soc. C. E. has surrendered its name and prestige they are gone. No one can foretell by whom or in what causes they may be exploited, or to what policies the society may be committed; for no one seems to know what are to be the objects, the methods, and the scope of the new organization.

It is urged that we should join the Federation because others are doing so. That is never a convincing argument, and in this case it is little short of absurd. No other body of engineers in the United States has so much to lose by joining the Federation as has the Am. Soc. C. E. It is easy to understand why the Federation should want the Am. Soc. C. E., but that is not an argument that should carry weight with the member who is thinking of what is best for the society and for the profession of which it is now the leading exponent. It is easy to understand why the promoters of the Federation should wish to absorb the Am. Soc. C. E. together with all the prestige and influence it has built up through the 68 years of its leadership; but this will but constitute additional reason for caution on the part of those who value that prestige and who are scrupulous as to the ends toward which that leadership may be directed.

We urge that in considering the Federation question the members of the Am. Soc. C. E. retain a firm grasp on these basic facts and principles. We urge a serious reading and consideration of the arguments against the Am. Soc. C. E. joining the Federation as prepared by Past-President Pegram, and Directors Alvord and Tuttle (see *Engineering News-Record*, Sept. 30, and sent to the membership together with the ballot. These arguments are just and sound. They will appeal to the member who understands and appreciates what the Am. Soc. C. E. is and stands for and who approaches the present problem animated only by a desire to do what is best for the society and the profession.

The standing of the Am. Soc. C. E. in the eyes of the world is the most valuable profesisonal asset that it brings to its membership. Let us not pawn this asset for the vague and questionable possibilities that may lie in the new Federation.

If you have already voted and wish to change your vote you may send in a new ballot and ask for the return of the first one.

ONWARD BATES, past president, Am. Soc. C. E.
J. WALDO SMITH, past vice-pres., Am. Soc. C. E.
ALEXANDER C. HUMPHREYS, past director, Am. Soc. C. E.
JOHN G. VAN HORNE, past director, Am. Soc. C. E.
CHARLES F. LOWETH, past vice-pres., Am. Soc. C. E.
DABNEY H. MAURY, member, Am. Soc. C. E.
CHARLES L. STROBEL, past vice-pres., Am. Soc. C. E.

NEWS OF THE WEEK

New York, October 14, 1920

Large Bond Issues Asked for New Jersey Highway Bridge Work

Eighteen million dollars for highway bridge reconstruction are asked of the New Jersey legislature by the new state highway commission. Of the total, $4,000,000 is required for immediate renewal of bridges now unsafe, and $2,000,000 for repairs and temporary reconstruction of 200 out of the 600 bridges now on the state's highway system, while ultimately $12,000,000 more will be needed for bridge replacement. The money is to be raised by bond issues authorized by a referendum vote to be ordered by the next legislature.

Development of a state highway system now including sixteen lines of road, or "routes," has been proceeding for two years, but a number of important bridges on these routes are in such condition that immediate replacement is needed. Charles A. Mead, department engineer of bridges, has reported that seven of the most important bridges are in such condition that they must be renewed at once, and that repairs costing over $300,000 will have to be done to keep them open for traffic until the new bridges are completed. For these large structures and for urgent repairs on about 200 smaller bridges a total of $6,000,000 is required within the next three years.

"It is our view that this work cannot be ignored if traffic is to be maintained on the highways," says the commission. "The sum of $18,000,000 will have to be provided eventually to build highway bridges adequate to meet the demands of the present traffic and to form fitting links in the state highway system. These estimates are based upon present-day costs."

Included in the seven large projects that are reported to be urgent, rebuilding of the Amboy bridge over the Raritan River will require $2,700,000; this bridge is now restricted to loads of 5 t., but the new one of 20 t. capacity is contemplated. Reconstruction of the Matawan Creek bridge ordered by the War Department, will cost $225,000, Cooper's bridge over the Navesink River and the Manasquan bridge $400,000 and $470,000, the Shark River bridge $260,000, and the Pine Brook bridge over the upper Passaic River $130,000.

The commission says, "Unless the rivers and smaller bodies of water are spanned with suitable structures, the good which we hope the citizens of the state who use the roads may derive from them will be lessened. The bridges are an integral part of the highway construction.

American Society C. E. Amendments to Constitution Defeated

In Letter Ballot of Record Size Proposed Changes in Administrative Machinery Fail To Secure Necessary Two-Thirds Majority Vote

Proposed changes in the constitution of the American Society of Civil Engineers, involving, (1) an enlargement of the scope of the organization to include co-operation in economic and civic affairs; (2) establishment of Local Sections and assignment of all members thereto; (3) reduction in the number of directors from District 1 (New York City); and (4) a new basis for the nomination and election of officers, including an annual conference of Local Section representatives, were defeated in the referendum vote in which 4 521 ballots were canvassed Oct. 6 at the meeting of the society in New York City. The remaining three of the seven proposed constitutional amendments, providing for an increase in annual dues, a change in the election of honorary members and a prohibition against the candidacy for office of a member of the nominating committee were carried. The result is, in effect, a repudiation of the measures advocated by the Joint Conference Committee.

A record vote on the seven questions was polled. In all 4,781 ballots were received; of these 260 were invalid, leaving the net ballots counted 4,521. In every case the majority of the votes cast was in favor of the proposed amendments but a change in the constitution of the society can be made effective only by a two-thirds affirmative vote, so that amendments A. B. F and G, although favored by the majority, were defeated by margins of 224 ballots, for amendment A; 416 ballots, for amendment B; 307 ballots for amendment F; and 448 ballots for amendment G.

A study of the vote by districts shows, in the case of the proposal to enlarge the scope of the Society (amendment A) a heavy negative vote from New York, there being 509 "No" against 318 "Yes." In the eastern Pennsylvania region the reverse was true, the "Yes" vote being 309 against 115 "Noes." Amendment A was also favored by substantial majorities in western Pennsylvania, Illinois, Michigan, Wisconsin, Minnesota, Texas and the Pacific Coast States. New England was very evenly divided. The full details of the vote by districts is given in the accompanying table.

As explained in this journal last week (p. 719) amendment A proposed the co-operation of the Society in civic and economic affairs. Amendment B covered the establishment of Local Sections. Amendment C increased the an-

RESULTS OF LETTER-BALLOT, AM. SOC. C. E. AMENDMENTS

	Ballots Counted Upon Amendment:													
	"A"		"B"		"C"		"D"		"E"		"F"		"G"	
District* No.	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
1—Foreign	36	29	22	43	43	21	48	15	53	11	29	33	26	37
1—Resident	318	509	278	549	578	224	556	240	592	207	278	544	262	555
2	158	176	140	192	234	86	262	57	279	41	150	184	135	196
3	120	126	109	137	139	102	171	69	179	63	121	125	111	132
4	309	115	303	123	338	80	361	54	379	39	305	117	300	120
5	190	112	182	120	222	77	238	62	245	54	190	111	170	128
6	294	123	280	138	322	88	334	76	360	49	287	129	271	141
7	270	57	258	69	260	64	262	56	263	56	268	56	256	67
8	254	144	243	153	275	110	302	84	324	64	236	158	224	169
9	147	107	129	125	171	79	195	53	208	41	147	104	131	118
10	154	80	145	89	158	71	184	48	198	35	148	83	141	91
11	224	53	206	71	210	62	230	43	253	22	218	57	206	66
12	156	27	153	31	143	41	152	26	165	15	155	28	150	31
13	146	65	136	75	131	80	151	55	172	35	143	68	132	78
Total	2,776	1,723	2,584	1,915	3,224	1,185	3,446	938	3,670	732	2,675	1,797	2,515	1,929
Required to carry	3,000		3,000		2,940		2,923		2,935		2,982		2,963	
Carried by	.....		.....		284		523		735		.....		.....	
Lost by	224		416		.....		.....		.....		307		448	
Total vote	4,499		4,499		4,409		4,384		4,402		4,472		4,444	
Percentage "Yes"	62		57		73		79		83		60		57	

* *Dist.* 1, N. Y. City and foreign; *Dist.* 2, New England States; *Dist.* 3, N. Y. State and Quebec; *Dist* 4, eastern Penn., Md., N. J., Del.; *Dist.* 5, D. C., Va., N. and S. C., Ga., Fla.; *Dist.* 6, Western Penn., W. Va., Ohio; *Dist.* 7, Ontario, Mich., Wis., Minn., Manitoba, Ia.; *Dist.* 8, Ill., Ind., Ky., Tenn.; *Dist.* 9, Ala., Miss., La., Ark., Mo.; *Dist.* 10, Okla., Kan., Col., Utah, Neb., Wyo., N. and S. D., Mont., Saskatchewan and Alberta; *Dist.* 11, Tex., Mex., Ariz., S. Cal.; *Dist.* 12, B. C., Idaho, Wash., Ore., Alaska; *Dist.* 13, Northern Cal., Nev.

nual dues. Amendment D provided for changes in electing honorary members. Amendment E prevented nominating committee members from running for office. Amendment F reduced the number of directors from the New York District. Amendment G involved changes in the administration of the Society's affairs.

All Factors in Building Industry Plan Harmony Congress

Seven elements in the building construction field are to hold a congress in June, 1921, or sooner, to discuss the problems of the field from every angle with a view to obtaining better coordination and giving better service to the public. A preliminary meeting of six of the interests involved—architects, contractors, sub-contractors, labor, engineers and material men—met Sept. 27 in Chicago and appointed a steering committee of six to study the situation and make plans for the congress. The seventh interest yet to be interested in the movement is the financial, to be represented by the Investment Bankers' Association. The committee appointed is as follows: R. D. Kohn, representing the American Institute of Architects; General R. C. Marshall, Associated General Contractors of America; Morris Knowles, Engineering Council; Wharton Clay, the material men; Louis K. Comstock, the sub-contractors; Thomas R. Preece, Building Trades Department of American Federation of Labor.

Each interest pledged itself to contribute $300 to a fund for incidental expenses. This meeting, attended by 32 men, followed a preliminary meeting in Atlantic City called by the American Institute of Architects at the same time as a meeting of the National Board for Jurisdictional Awards in the Building Industry. The members of the Board of Awards are selected by the American Institute of Architects, Engineering Council, the Associated General Contractors of America, the National Building Trades Employers' Association and the Building Trade Department of the American Federation of Labor.

Increased Assessment for Miami Conservancy Flood Protection

An additional levy of 14 per cent of the total estimated flood benefits of the Miami Conservancy District has been made by the directors of the district, in addition to the original levy of 36 per cent made in September, 1917. The amount of $10,793,000 to be raised by this additional levy is made necessary by the increased cost of the work over that corresponding to the prices prevailing when the estimates were prepared. The board of directors states, however, that the increase in cost of the work does not compare at all unfavorably with the increased cost of similar enterprises.

State Highway Officials Support Federal-Aid Bill

Plans are being prepared by the American Association of State Highway Officials to support actively the Chamberlain bill, which proposes appropriations of $400,000,000 for the continuance of Federal aid in the construction of rural post roads. One-fourth of the appropriation is to be available during the fiscal year ended June 30, 1922. The remainder is to become available in equal proportions during the following three fiscal years.

In extending the Federal aid, the Chamberlain bill proposes to make provision for the public land states. The bill provides "that in each state in which the percentage of total land area to which the title of the United States is unqualified, exceeds ten per cent of the total area of all lands in the state, the Secretary of Agriculture may reduce the ratio of co-operation required, but not to below one-half that which the total of the patented land and national forest land bears to the total area of all lands in the state." A separate fund is provided for national forest roads and trails.

Another provision of the Chamberlain bill is that preference is to be given "such project as will expedite the completion of an adequate national highway system, connecting at the state boundary."

League to Further Irrigation Needs Formed in Northwest

At an irrigation congress held recently in Seattle and attended by more than seven hundred delegates from northwestern states, there was formed the Northwestern Reclamation League which is to further the irrigation needs of that territory. The league will undertake a nation-wide campaign of education to arouse public sentiment on the need for Federal legislation that will promote reclamation of arid lands in the West; it will make a systematic effort to show the manufacturers of the East how the reclamation of arid lands in the West will open new markets to them, and the United States Chamber of Commerce is to be asked to appoint a committee to do educational work on this general subject through its affiliated state and local chambers. Officers of the new league are: president, James A. Johnson, farmer and banker, Shelby, Montana; secretary, James A. Ford, managing secretary Spokane Chamber of Commerce.

Philadelphia Section, Am. Soc. C. E., for Federation

At a meeting held Oct. 4 the Philadelphia Section of the American Society of Civil Engineers passed a resolution introduced by Richard L. Humphrey, endorsing the Federated American Engineering Societies and advocating the entry of the Am. Soc. C. E. into the new organization.

Engineer Heads Roadmasters' Society

The engineering side of railway maintenance-of-way work was made prominent at the recent annual meeting of the Roadmasters and Maintenance-of-Way Association, held in St. Louis. Weight of rail in economic relation to traffic was the subject of a report by J. B. Baker, engineer of maintenance of way, Pennsylvania system. In the discussion of a paper on maintenance of rail joints by R. H. Howard, chief engineer of maintenance of way, Wabash R.R., several members referred to the modern practice of oiling splices and bolts to prevent rust and to facilitate removal. Repair of frogs and switches by welding by the oxyacetylene process was approved in the report of a committee headed by M. Lipman, division engineer of the Pennsylvania system, but it was pointed out that only competent men should be allowed to operate the apparatus. So far the process has not been successful with manganese steel parts. The committee did not recommend it for frogs and switches in high speed tracks and Mr. Muff, A., T. & S. F. Ry., finds it economical to send the parts to the shop for welding rather than to do the work in the track. Cutting bolt holes in rails with torches has been discontinued on the Missouri Pacific Ry., as rails have fractured at holes made in this way. On the Pennsylvania system electric welding has been found less satisfactory than the oxacetylene process.

Methods of increasing the efficiency of track forces were discussed in a paper by F. G. Jonah, chief engineer of the St. Louis-San Francisco Ry. (see *Engineering News-Record*, Sept. 30, 1920, p. 662); H. J. Pfeifer, chief engineer of the Terminal R.R. Association of St. Louis, pointed out that with the present high rates of wages it is important for roadmasters to see that their men give a proper equivalent in labor. As to the use of motor section cars, it was stated that the Elgin, Joliet & Eastern Ry. is using cars large enough to carry 25 men. Training foremen in special extra gangs and the establishment of a general roadmaster on each division were ideas advocated in a report by Wm. Shea, C., M. & St P. Ry.

The future of the tie supply was discussed in a paper by H. Von Schrenk, consulting engineer, who advocated wider use of preservative methods and more care in getting full life out of ties in the track. A report on road crossings, by J. B. Martin, New York Central Lines, dealt mainly with bituminous macadam (see *Engineering News-Record*, Oct. 9, 1919, p. 696), and discussion showed that this construction is in use on several roads, including the Chicago & Northwestern Ry. and the Lehigh Valley R.R. It appears that as a rule no plank or guard rail is used, the flangeway being formed in the paving. A report on the equation of track values, by L. C. Ayers, assist-

ant superintendent, Norfolk & Western R.R., gave various items of work as equivalent to the maintenance of one mile of main track.

The officers elected for 1920-21 include the following: president, W. P. W. Wiltsee, assistant engineer, Norfolk & Western R.R., Roanoke, Va.; secretary, J. P. McAndrews, roadmaster, Chicago & Northwestern Ry., Sterling, Ill. The next meeting will be held at Chicago in 1921.

The following subjects have been selected by the Roadmasters and Maintenance-of-Way Association for presentation at the annual convention in 1921: Records and accounts of a roadmaster's office, F. J. Meyer, assistant engineer, New York, Ontario & Western R.R.; classification of second hand rail, Wm. Shea, general roadmaster, Chicago Milwaukee & St. Paul Ry.; economical methods of laying and renewing ties, G. S. Brooks, general roadmaster, Terminal Railroad Association of St. Louis; construction and maintenance of railway track crossings, D. O'Hearn, roadmaster, Elgin, Joliet & Eastern R.R.; stimulating rivalry between section forces, G. W. Koontz, roadmaster, Delaware & Hudson R.R.

Convention Discusses Smoke

The advantages of smoke prevention and the objectionable effects of smoke were presented in various aspects at the recent Chicago convention of the Smoke Prevention Association. Education was considered to cover 90 per cent of smoke reduction, which means that any move to reduce smoke must begin with the higher officials. To eliminate the widespread nuisance from domestic smoke, Dr. E. V. Hill, of the Chicago smoke department, suggested that the city should purchase the gas plants, install byproduct ovens and utilize the coke for domestic fuel. He suggested also the use of central heating plants, each serving an entire block or several blocks. Mr. Kreisinger, U. S. Bureau of Mines, thought the coal having less than 10 per cent ash might be used in byproduct plants, but that coal of higher ash content should be used in mechanical stokers or pulverized coal furnaces. Pulverized lignite has been burned successfully. A great part of the proceedings related to furnace design and accessories. Locomotive equipment and firing methods were also discussed. The president is J. M. Lonergan, New York; secretary, F. A. Chambers, Chicago. The 1921 meeting will be held at St. Louis.

Bridge Patent Suit Settled

Claims for infringement of patents in several bascule bridges over the Chicago River, brought against the city of Chicago by the Strauss Bascule Bridge Co., have resulted in an agreement by the city to pay $348,500. Two court decisions had been rendered in favor of the company and the city decided to settle rather than continue the case.

International Road Congress Officers Are French Engineers

Both the new president and secretary-general of the Permanent International Association of Road Congresses, elected at the meeting held in Paris, June 21, are engineers in the Ponts et Chaussées in the (Department of Bridges and Roads) Ministry of Public Works, France, and both have distinguished

ALBERT MAHIEU, PRESIDENT, PERMANENT INTERNATIONAL ASSOCIATION OF ROAD CONGRESSES

civil and military professional records. Albert Mahieu, former colonel of engineers, the new president of the association, is also counsellor of state, inspector-general of bridges and roads and secretary-general of the Ministry of Public Works. Paul le Gavrian, former lieutenant-colonel of engineers, is secretary-general of the association and chief engineer, Direction of Roads, Ministry of Public Works, France.

M. Mahieu was graduated from the Ecole Polytechnique in 1884. After graduation as engineer of bridges and roads he was active in highway and railroad construction in central France and at Paris. During this period he made especial studies of road construction and maintenance and became one of the best known of the French road engineers.

In 1908 he was charged by the Minister of Public Works with the organization of the first international road congress, whose secretary-general he became upon its permanent organization. As a member of the executive committee he assisted materially in planning and presiding over succeeding congresses held at Brussels in 1910 and London in 1913. When war was declared M. Mahieu was commissioned a colonel of engineers and was placed at the head of the service of military roads of all the French armies, a position he held through the war. After the war he again became active in work for the association and when, at the June, 1920, meeting, Mr. de Preaudeau, because of ill health, resigned as president, M. Mahieu was the unanimous choice as his successor.

M. le Gavrian, the association's new secretary-general, is a graduate of the Ecole Polytechnique and of the Ecole des Ponts et Chaussées, Paris. Shortly after his graduation from the latter institution he assisted in the design and erection of the large structures built for the Paris Exposition, and also the public boulevards, among them Avenue Alexandre III, and water, gas and sewer installations.

In 1901 M. le Gavrian was given, at Versailles, one of the most important highway road posts in France. Effects of automobile traffic had just then begun to be felt and he began intensive study of road construction and maintenance with the new factors taken into account. He was among the first engineers to introduce into France systematic use of tar for highway construction and maintenance. He experimented in various road products such as tar, pitch, petroleum oils, bitumen and asphalt, and finally established French technique in construction of aggregate mixture surfaces. Upon the organization of the first congress M. le Gavrian arranged the technical details.

At the outbreak of war M. le Gavrian was commissioned lieutenant-colonel of engineers and charged with directing the road service of the French Sixth army. In this capacity he took part in the battles of the Somme, Aisne, Chemin des Dames, the second battle of the Marne and Chateau Thierry. In 1918 he was attached to the French Mission at G.H.Q., A.E.F., in which position he co-operated with the American First and Second armies in the repair and maintenance of the roads in the Toul, St. Mihiel and Verdun sectors. After the armistice he was attached to Marshal Foch's staff and made responsible road officer with the French army of occupation.

Demobilized in April, 1919, M. le Gavrian resumed his work as chief

PAUL LE GAVRIAN, THE ASSOCIATION'S NEW SECRETARY-GENERAL

engineer, Direction of Roads, Ministry of Public Works. Early this year he was named professor at the Ecole Nationale des Ponts et Chaussées.

James A. McCrea, Engineer, Vice-President of the P. R. R.

Col. James A. McCrea, previously engineer, maintenance-of-way, Pennsylvania R.R., Lines East, who during the war served as deputy director general of transportation, has been selected to succeed the late Richard L. O'Donnel as vice-president of the Pennsylvania Railroad system, in charge of the Central Region, with headquarters at Pittsburgh. Under the reorganization of the Pennsylvania R.R., dividing it into four grand divisions, over each of which is appointed an operating vice-president, the Central Region embraces por-

COL. JAMES A. McCREA

tions of what were formerly both the Western and Eastern Lines including the entire Pittsburgh district, one of the greatest railroad traffic producing territories in the world, extending from Altoona in the East to Columbus, Ohio and the Lake ports.

For the past two years Colonel McCrea has been vice-president of the Bankers' Trust Co., New York City, and previous to the war was general manager of the Long Island R.R. He was graduated from Sheffield Scientific School of Yale University in 1895 and entered the chief engineer's office of the Pennsylvania Lines West of Pittsburgh as a draftsman, later engaging in field work. Within two years he was appointed assistant engineer and in 1889 became engineer, maintenance-of-way of the Pennsylvania R.R., Lines East.

After his appointment as engineer, maintenance-of-way, Lines East, Colonel McCrea returned to the Western Lines in 1901 as superintendent of the Cincinnati Division, where he remained for five years. He was then transferred to the Long Island R.R. as general superintendent and became general manager in 1911. Upon his return from France in March, 1919, he left railroad service to become vice-president of the Bankers' Trust Co.

During the war Colonel McCrea rendered noteworthy service as general manager and later deputy director general of transportation of the American Expeditionary Forces, in recognition of which he was awarded the Distinguished Service Medal of the United States and was made an officer of the French Legion of Honor. Colonel McCrea is son of the late James McCrea who was the chief executive of the Pennsylvania R.R. from 1907-1913 and who for twenty years was vice-president of the company at Pittsburgh.

Road Machinery Company Cited for Unfair Competition

The Federal Trade Commission has cited the Eastern Road Machinery Co., Boston, Mass., in a complaint of unfair competition in the sale of road building machinery. Forty days are allowed the respondent in which to file an answer, after which time the case will be set for trial on its merits.

The company is required to answer an accusation that it has given to public officails and to employees of its customers sums of money and gratuities as inducements to influence them to recommend the purchase of the respondent's road making machinery.

A. A. E. Presents to I. C. C. New Definition of Engineers

At a hearing Oct. 1 granted the American Association of Engineers by the Interstate Commerce Commission a new definition was presented under which professional engineers in railroad service, classified as subordinate officials, are included. The term "engineers of mechanics" as defined after the I. C. C. hearing March 15 now includes civil engineers. It is recommended that there shall be included in the group within the term "subordinate officials" the following:

TECHNICAL ENGINEERS — This class shall include all professional engineers, assistant engineers, engineer assistants, instrumentmen, rodmen, chainmen, designers, draftsmen, computers, tracers, chemists, architects, engineer supervisors, engineer inspectors, and all other employees engaged in office or field work in any department and performing engineering work. None of the foregoing who have authority to employ, discipline, or dismiss subordinates shall be included.

The Commission has taken the matter under advisement and will probably make a decision within the next two weeks. George W. Hand, assistant to the president, Chicago and Northwestern Ry. Co. and chairman of the national railroad council of A. A. E., presented the substitute definition. He was accompanied by J. B. Jenkins, valuation engineer, Baltimore & Ohio R.R. Co., C. C. Burritt, office engineer, Southern Railroad, and R. C. Bailey, district secretary, A. A. E.

N. Y. Section, Am. Soc. C. E., Will Discuss Freight Distribution

The New York Section of The American Society of Civil Engineers will hold a meeting at the Engineering Societies Building, 29 West 39th St., New York City, on the evening of Oct. 20. The subject for discussion will be the local distribution of freight and food products. All members of the society are invited to attend.

Water Master Plan Introduced in California

Irrigationists supplied by water from Kings River in California organized early this year and after agreeing upon the individual rights and priorities involved asked the State Water Commission to place one of its engineers in charge of apportioning the water to the various canals. The Commission complied with this request and after the season's experience with the water master plan, tried out this year for the first time in California, found it to be such a success that in an announcement relating to the plan, the Commission says: "Neither the people nor the state will endure the waste."

As long ago as 1917 a bill was introduced in the State Legislature giving the Commission authority to place water masters upon all the large streams of the state, but the plan was then little understood and met with so much opposition that it was abandoned. In the absence of any joint plan the superintendent of each irrigation canal has been responsible to the water users under his canal for seeing that their full share of water was secured. This method is fairly satisfactory in time of abundant water but in time of drought the result has been found to be endless dispute and friction, expenditures for litigation and for checking rival claimants as well as extensive waste of water. Hence the low water of the past three years in California has been a factor in getting the water master plan into operation.

The Kings River system, one of the most important of the state, supplies water for 625,000 acres. This area is served by about 20 large and 25 small canals, many of which must be supplied in accordance with rights that vary with the seasons or total flow. The water master is expected to make equitable distribution in conformity with all the varying conditions. In addition to the constant variations in the river itself, occurring not only from day to day but from morning to night, the apportionment has to be adjusted for all such factors as sudden hot spells that melt the snow, thunder showers, accidents to canals or headgates, dangers of overflow, etc. Under these varying conditions it is part of his duty, in the words of the State Water Commission, "to keep reasonably satisfied the several thousand irrigators normally suspicious of each other."

Break Ground for Hudson Vehicle Tubes

The ceremony of breaking ground for the vehicular tunnel under the Hudson River between the states of New York and New Jersey took place Oct. 12 at the site of one of the ventilating shafts near Canal and Washington Sts., New York City.

Engineer Officers Commissioned

As a result of the recent examinations, the following appointments as commissioned officers in the Corps of Engineers of the Army have been announced:

To be Majors: Peter M. Anderson, Washington, D. C.; Harry F. Cameron, Washington, D. C.; Samuel F. Crecelius, Richmond, Ky.; Malcolm Elliott, Florence, Ala.; Elihu H. Ropes, Washington, D. C.

To be Captains: James D. Andrews, Jr., Camp Zachary Taylor, Ky.; Samuel L. Damon, Camp Travis, Tex.; James M. Farin, Chicago; George A. Geib, Gilbert, Me.; Lewis C. Gordon, Fort Scott; Robert C. Hunter, Wollaston, Mass.; William S. Kilmer, Washington, D. C.; Harry D. W. Riley, Zone Supply Office, Washington, D. C.; Harry O. Tunis, Baltimore; Elliot Vandevanter, Hanover, Md.; Harry D. Vaughan, Camp Taylor, Ky.

To be First Lieutenants: O. G. Hoaas, Wichita, Kan.; Albertis Montgomery, Camp Travis, Texas.

ENGINEERING SOCIETIES

The New York Section, American Water Works Association will hold its October meeting at Hotel McAlpin, New York City, Oct. 20. There will be an opening luncheon followed by an illustrated talk by George C. Whipple on "Eight Months in Europe with the League of Red Cross Societies."

The Iowa Section, American Water Works Association will hold its sixth annual convention Nov. 5 and 6 at Iowa City. Since the section now includes Wisconsin, Missouri, Nebraska and South Dakota, the name will probably be changed at this meeting.

The Louisiana Engineering Society, at its meeting of Oct. 11, listened to a paper on "Present Status of the Sewerage, Water and Drainage System of New Orleans," by George E. Earl, general superintendent, Sewerage and Water Board.

The Engineering Society of Buffalo, at its meeting of Oct. 5, was addressed by J. R. Bibbins of the Arnold Co., Chicago, on "Technical and General Problems Involved in City Building," illustrated by lantern slides. Capt. George H. Norton, city engineer, spoke on Buffalo's municipal engineering problems, and Harry J. March, engineering executive, Buffalo City Planning Commission, showed, with a series of lantern slides, the growth of Buffalo up to the present and the application of the engineering principles necessary to adequately provide for the greater Buffalo of the future.

The Detroit Engineering Society announces the following program: Oct. 15, "Relationship of Foreign Labor to Its Employers," by Frank J. Raymond, of the Inter-racial Council; Nov. 5, "Conditions in Europe from a Political, Social and Engineering Standpoint," by E. J. Mehren, editor of *Engineering News-Record;* Nov. 19, "New Water Filtration Plant for Detroit," by Major T. A. Leisen, engineer for the Board of Water Commissioners.

The Illinois Section, Am. Soc. C. E. was addressed Sept. 28 by President Arthur P. Davis on the constitutional amendments pending before the society. The section will meet Oct. 14, at the rooms of the Western Society of Engineers, to discuss the proposed entrance into the Federated American Engineering Societies.

The San Francisco Engineering Council at its September meeting adopted a new constitution which reduces the membership of the council to three representatives of each individual section or society and increases the number of societies represented to include the following: San Francisco Sections of the American Society of Civil Engineers, American Institute of Electrical Engineers, American Society of Mechanical Engineers, American Institute Mining Engineers, American Chemical Society, Pacific Association of Consulting Engineers, and the American Association of Engineers. Further plans for the California Engineering Council were discussed, and it was also decided to urge upon the San Francisco Chamber of Commerce action in the matter of interesting the Federal Government in dredging a deeper channel across the bar at the entrance to San Francisco Bay.

The Southern California Section, Am. Soc. C. E. held a meeting at Los Angeles, Sept. 22, at which J. C. Allison addressed the members and guests on "A Final Solution of the Irrigation and Flood Control Problem of the Lower Colorado River." Mr. George G. Anderson discussed the details of the efforts of the society's Committee on Development and the events leading up to the submission to the membership of the proposed amendments to the constitution. He pointed out the urgent necessity of a full and representative vote on these amendments and urged all to vote.

The Engineers' Club of Philadelphia announces the following October meetings: Oct. 8, American Institute of Electrical Engineers—afternoon session "Technical Session on Economics of Power Plants," with addresses on "Economic Study of Secondary Distribution" by P. O. Reyneau and H. P. Seelye, and "Electrical Demand Measurements" by P. A. Borden; evening session, "Session in Commemoration of the Discoveries of Arago, Ampere, Davy and Oersted" Principal speakers, Prof. Elihu Thompson and Prof. M. I. Pupin. Oct. 8, American Society of Marine Draftsmen. Oct. 12, Tuesday luncheon address "Bureau of Standards and Its Engineering Contacts" by Dr. George K. Burgess. Oct. 13, American Association of Engineers. Oct. 14, American Society of Heating and Ventilating Engineers: "Résumé of the Work of the Research Bureau" by Dr. John R. Allen. Oct. 15, Illuminating Engineering Society. Oct. 16, Smoker, "A Trip Across the Andes and Through Chile" by Senor Richard Barrous, Special Commercial Commissioner to the United States for Chile. Oct. 19, Tuesday luncheon address, "The Inspiring Outlook for American Engineering" by Morris L. Cooke. Oct. 19, Regular meeting of Engineers' Club, "The Development of the Technique of Changing from the 2-Shift to the 3-Shift Day in a Continuous Process Industry" by Robert B. Wolf, consulting engineer. Oct. 20, Society of Automotive Engineers, "The Future of Highway Transportation as It Affects the Automotive Engineer" by C. M. McCreery. Oct. 21, American Chemical Society. Oct. 22, American Society for Steel Treating. Oct. 26, Tuesday luncheon address. Oct. 26, American Society of Mechanical Engineers, "Bearings" by Albert Kingsbury. Oct. 27, Society of Municipal Engineers, address by Hon. J. Hampton Moore, Mayor of Philadelphia. Oct. 28, American Welding Society.

PERSONAL NOTES

R. H. COULSON has been appointed district engineer of the Western District, New York Central Lines, with headquarters at Buffalo, succeeding the late N. F. Thompson.

W. O. WASHINGTON, recently engineer of Caldwell County, Tex., has been appointed highway engineer for Cameron County, which is planning a system of concrete roads. His headquarters are at Brownsville, Tex.

C. S. SHAUGHNESSY, formerly engineering examiner in the New York City Civil Service Commission, has been appointed chief examiner of the Civil Service Commission of Philadelphia. He is the first engineer appointed to such an office.

JACKSON R. CRISSEY has resigned as city engineer of Johnstown, Pa., to enter the field of construction. Mr. Crissey entered the employ of the city fourteen years ago as a field engineer and was city engineer for seven years.

FRANK BACHMANN, chief chemist Industrial Waste Board, Connecticut State Department of Health, and recently in charge of the sewage experi-

mental plant at New Britain, has severed his connections with that board to join the staff of the Sanitary Engineering Department of the Dorr Co.

MONROE L. PATZIG consulting engineer, Des Moines, has been appointed plant inspector for asphaltic paving materials now being used in Rock Island, Ill.

T. W. NORCROSS has been appointed chief engineer of the Forest Service, U. S. Department of Agriculture, succeeding O. C. Merrill, who recently resigned to become executive secretary of the Federal Power Commission.

S. J. HUNGERFORD, of Toronto, has been appointed vice-president of the Canadian National Railways. He has been in railway work from youth, starting as a machinist's apprentice with the C. P. R.

M. H. MACLEOD, of Toronto, has been appointed vice-president in charge of construction of the Canadian National Railways. Mr. MacLeod was formerly chief engineer at Winnipeg for the Canadian Northern Ry.

ARTHUR S. MILINOWSKI and JOHN F. DRUAR have become associated under the firm name of Druar & Milinowski, consulting engineers, St. Paul, Minn. The firm will conduct a general engineering practice, specializing in municipal improvements and public utilities. Mr. Milinowski was formerly assistant engineer on barge canal construction in the department of the New York State Engineer, at Rochester, N. Y. Mr. Druar has been engaged in similar work at St. Paul for the past twelve years.

R. E. MCDONNELL, of Burns & McDonnell Engineering Co., consulting engineers, Kansas City, Mo., was elected president of the Southwest Water Works Association at the ninth annual meeting in New Orleans, Sept.24.

WALTER PAGE, president Page & Co., Ltd., contractors, Toronto, has been elected president of the Ontario Paving Brick Co., Ltd., Toronto.

OBITUARY

JAMES H. SHERMAN, president Sherman Engineering Co., of Kansas City, Mo., died on Oct. 2. He was 36 years old. During the 18 years of his engineering work he spent four years with the Pere Marquette and New York Central railroads; seven years with the Truscon Steel Co. as designer and assistant district manager; one year with the American Rolling Mill Co. as manager of its metal lath department; four years with the Lehrack Construction Co., Kansas City, and the Burrell Engineering & Construction Co., Chicago, as chief engineer; and the last two years of his life as president of the Sherman Engineering Co., which he organized for the purpose of specializing in the design of grain elevators and flour mill buildings.

JOHN D. ISAACS, JR., chief engineer, S. J. Junkins & Co., Ltd., was killed Oct. 1 by the accidental discharge of a shotgun while hunting duck at Lake Manitoba, Canada. Mr. Isaacs was the son of John D. Isaacs, consulting engineer of the Southern Pacific Co. at New York. He was born in Oakland, Cal., in 1882 and was educated at the University of California. During this period he took a leave of absence of one year to become engineer of construction of the Yosemite Valley Ry. After leaving college he entered the service of the Harriman System in the engineering department. He had charge of the location and construction of the line from Chehalis to Aberdeen, Wash., and later was engaged in track elevation and building construction work for the Oregon-Washington Railroad & Navigation Co. in Spokane, where he initiated original methods for moving large concrete abutments in connection with track elevation work. For the last few years Mr. Isaacs had been associated with the Junkins company and had had charge of extensive wharf and dock work carried out by that company for the Canadian Pacific R.R. at Vancouver. He also had charge of hydro-electric surveys and development work in the Canadian Northwest, some of which were notable for having been carried out during the winter season, when it had been thought impossible to accomplish such work at this time of year. At the time of his death he was in charge of work for the Junkins company, lining the Connought tunnel, formerly known as the Roger's Pass tunnel of the Canadian Pacific line.

Thrust Boring Machine

A new machine to appear in England is a hydraulic thrust boring machine, designed for use in boring horizontal holes up to 12 in. in diameter for pipe and cable installations. The new machine which eliminates both trench excavation and spoil disposal, inasmuch as boring is done by earth compression, receives the following description in a recent issue of *Engineering Review:*

Invented by Captain A. R. Mangnall and Captain Irving, this machine is claimed to revolutionize present practice for pipe and cable laying in that type of ground suitable for operation of the machine. The earth must be consolidated and possess clay in some percentage, and of a hardness not exceeding the stiffest blue clay. As this covers most of the cases where normal excavation can be carried out, the application of this machine is calculated to be widespread.

The ability of the machine will be realized when in half an hour, and departing only a trifling amount from the predetermined course, a hole 150 ft. long and 4 in. in diameter is made horizontally below the ground without disturbing the surface.

Small pits 150 ft. apart or other convenient distances are made in the ground, and, in turn, linked together by thrust-borings of the required size. Holes up to 12 in. in diameter can be made, and even larger sizes under certain conditions. Thrust-borings are made of any suitable depth required, and, as trench excavation is dispensed with, all surface reinstatement costs are eliminated.

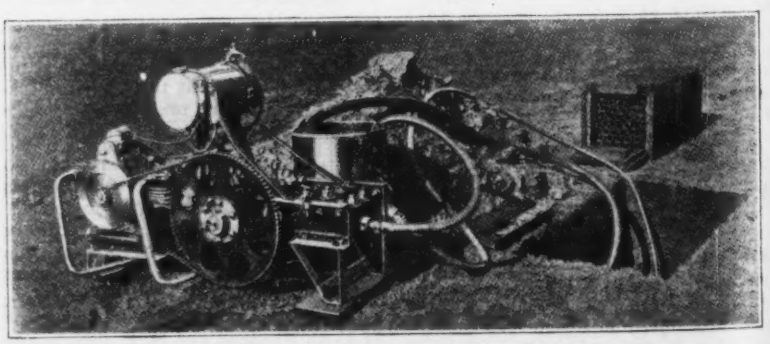
In thrust-boring the earth is compressed and displaced around the thrust-boring tool, there being no cutting action, and consequently no "spoil," to be disposed of. By virtue of this "compression" around the thrust-bore, the internal skin is hardening sufficiently to permit the feeding along its surface of heavy cables or pipes, without causing any material scouring of the bore.

The apparatus is portable, all the gear weighing only 13 cwt. for cable laying, while for the larger holes in pipe laying a heavier plant is required, but the weight depends largely on conditions.

The machine consists of an hydraulic cylinder carried on trunnions in a light steel carriage, and capable of being turned from a horizontal to a vertical position. Inside the cylinder is a piston with short guiding fingers. This "gun," complete in its carriage, is dropped onto its base framework in the pit, the rear end having suitable abutment members to take the load. The "gun" is connected by flexible pressure pipes to a small gasoline driven pump set. The water is in continual circulation through the system during the whole of the operation, only a small reservoir tank being required. The operation is begun by turning the "gun" into a vertical position and dropping the "pilot"—the "business end" of the thrust bar—into it.

The "gun" is turned down, and, after being aligned on its position at the next pit by suitable elevating and training gear, the pressure is admitted behind the piston and the pilot is thrust forward into the ground. The admission and exhaust valves are operated by one single lever. The gun is again raised, and the first extension piece pressed into it, the water being exhausted in this operation. The gun being again lowered, the pilot is thrust forward by the extension piece. This operation is repeated until the "pilot" breaks through into the next pit and the boring is completed. The whole cycle of raising the gun, inserting an extension piece, lowering the gun, making the coupling and thrusting the piece home, occupies less than one minute. The extension pieces are then withdrawn from the completed bore, and, on being uncoupled one by one, are placed in the case ready for boring at the next pit. Allowing for time in extracting these tubes, cleaning and moving the entire gear from pit to pit, at least two thrust borings can be made in an 8-hr. day, the thrust-boring screw consisting of three men.

The machine is manufactured by the Hydraulic Engineering Co., Ltd.,



THRUST-BORING SET INCLUDING EXTENSION JOINTS